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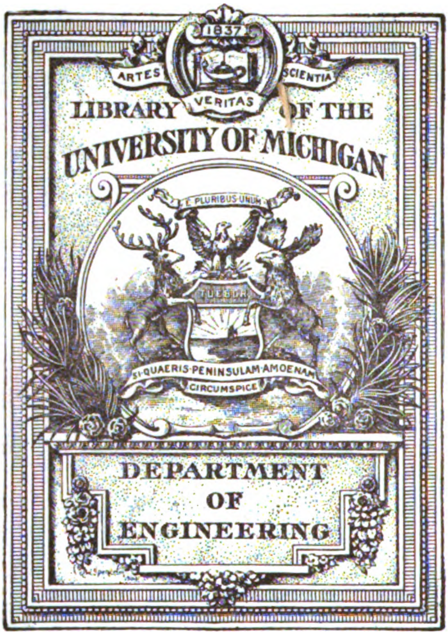

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ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY,

TO THE

SECRETARY OF WAR,

FOR

THE YEAR 1891.

IN SIX PARTS.

PART II.

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REPORT of Capt. W. L. Marshall, Corps of Engineers, Engineer Officer, on operations in Division of the Missouri, 3943; report of Capt. Charles H. Clark, Ordnance Department, Acting Engineer Officer, on operations in Department of the Columbia, 3945; report of Lieut. Charles A. Worden, Seventh Infantry, Acting Engineer Officer, on operations in Department of the Platte, 3946; report of Lieut. James E. Runcie, First Artillery, Acting Engineer Officer, on operations in Division of the Pacific, 3947.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

(CONTINUED.)

APPENDIX F.

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IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHWESTERN SHORE OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

REPORT OF CAPTAIN THOS. L. CASEY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. **Sumpawanus Inlet, New York.**
2. **Canarsie Bay, New York.**
3. **Sheepshead Bay, New York.**
4. **Arthur Kill, New York and New Jersey.**
5. **Channel between Staten Island and New Jersey.**
6. **Passaic River, New Jersey.**
7. **Elizabeth River, New Jersey.**
8. **Rahway River, New Jersey.**
9. **Raritan River, New Jersey.**
10. **South River, New Jersey.**
11. **Keyport Harbor, New Jersey.**
12. **Mattawan Creek, New Jersey.**
13. **Shoal Harbor and Compton Creek, New Jersey.**
14. **Shrewsbury River, New Jersey.**
15. **Manasquan (Squan) River, New Jersey.**
16. **Removing sunken vessels or craft obstructing or endangering navigation.**

EXAMINATIONS AND SURVEYS.

17. **Princess Bay, Staten Island, New York, for breakwater.**
18. **Hackensack River, New Jersey, from below the Newark and New York Railroad Bridge, on Newark Bay, to the town of Hackensack.**

UNITED STATES ENGINEER OFFICE,
New York, July 9, 1891.

GENERAL: I have the honor to transmit herewith my annual report on the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1891.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

F I.

IMPROVEMENT OF SUMPAWANUS INLET, NEW YORK.

Sumpawanus Inlet, known in the neighborhood and on the Coast Survey charts as Sumpawams Creek, is a small creek on the south side of Long Island, emptying into the Great South Bay. It lies about 36 miles east of New York City, 15 miles east of the western end of the Great South Bay, and nearly twice as far from its eastern end.

Fire Island Inlet, through which most of the waters of Great South Bay pass into the Atlantic Ocean, lies south-southeast of Sumpawams Creek, distance about 6 miles in a direct line, but 11 miles by the channel. The inlet is a tidal stream from 100 to 200 feet wide, running up to the town of Babylon, Long Island, which lies less than a mile north of the mouth. It is crossed here by a dam, which forms a reservoir for the fresh water of a small creek which supplies the town with water. The mean rise and fall of the tides at the mouth of the inlet is only 1.3 feet, and the bottom of the bay and of the inlet is soft mud.

The first survey of Sumpawams Creek of which we have any record was ordered by act of Congress, approved June 14, 1880, and was made during the fall of 1881, under the direction of Gen. (then colonel) John Newton, Corps of Engineers. His report may be found in the Annual Report of the Chief of Engineers for 1881, Part I, page 653.

The project of improvement, based upon this survey, provided for dredging a channel 150 feet wide and 5 feet deep at mean low water from the 5-foot curve in the bay to the steamboat dock at the mouth of the creek, a distance of about 1,500 feet, and thence 5 feet deep and 100 feet wide up the inlet to the town of Babylon, a distance of about 3,500 feet farther. The estimated cost of making this improvement was $23,115.

The mean range of tides at the mouth of the inlet being only 1.3 feet, there was practically no current swift enough to produce scour. The depth of water in the proposed channel, at the time of the survey, was from 1 to 3 feet in the creek and from 3 to 5 feet outside. It was not believed that diking would assist in improving this entrance, and inquiry showed that the depth of water both outside and inside the inlet had materially diminished in late years.

The amount expended under the project to June 30, 1890, was $7,000, giving a channel 75 feet wide and 5 feet deep from the steamboat wharf to a point 750 feet below it, besides two cuts, each 25 feet wide, alongside the wharf. Outside of the cut so made and extending to the 5-foot curve in the bay a shoal was left on which the depth was only about 4¾ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to 4½ feet. This was to have been anticipated, as appears by the preliminary report made by General Newton. The 5-foot curve in the bay was 1,500 feet from the steamboat wharf, but inside this curve, for about 750 feet towards the wharf, lay the flat.

The commerce of Sumpawams Creek is essentially that of Babylon, a small town of from 3,000 to 5,000 inhabitants, 1 mile above the mouth of the creek, depending almost entirely upon summer trade of the hotels and the cottages along the north shore of Great South Bay and on Fire Island Beach.

The commerce of Babylon by water has been decreasing, apparently because the Long Island Railroad has taken away the seagoing business. Babylon itself has improved, and has become a fashionable summer resort. At present its commerce by sea is carried on by three passenger steamboats, drawing from 4 to 5 feet, running in summer to Fire Island Beach; three schooners, drawing from 5 to 5½ feet, carrying brick, lime, lumber, and other heavy freight to Babylon the year round; one hundred sloops and pleasure boats, drawing from 1 to 2 feet of water, taking out sailing and fishing parties in summer, of which seven or eight remain in use during the winter, fishing and taking oysters and clams to Patchogue, Sayville, and New York.

The commerce of the creek, in my judgment, does not warrant the formation of a channel more than 5 feet deep from the 5-foot curve in the bay to the steamboat wharf, for the convenience of the few steamers and schooners which make use of the creek.

It is stated that the shoals in the bay kill the sea so entirely that pleasure boats can now lie in the mouth of the creek in all weather.

So far as the extension of the improvement from the steamboat dock up to the inlet is concerned there appears to be no reason why the Government of the United States should undertake it.

The original estimate of the cost of the work was $23,115. Seven thousand dollars have been appropriated.

Ten thousand dollars can be expended in giving a 5-foot channel out into the bay for the use of steamboats, but I think that the work is more a matter of local than public interest.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fire Island Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1891, was $147,538,045.69.

Original estimate	$23,115
Amount appropriated	7,000
Amount expended	7,000

Money statement.

Amount (estimated) required for completion of existing project	$16,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following statistics relative to commerce of Sumpawanus Inlet, New York, during the past year, were kindly furnished by the Hon. Jas. B. Cooper, justice of the peace, Babylon, Long Island:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Oysters and clams	60	$24,000	Steam	10	4½	90
Fish	200	24,000	Sail	380	3	10
Building material	1,000	8,500				
Miscellaneous	18	1,800				
Total	1,278	58,300		390		

The steamboats running to and from Fire Island Beach carried 10,000 passengers during the past year.

There has been no change in commerce during the past year.

F 2.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

The first survey of this bay with a view to its improvement was made in 1879. The scheme of improvement involved a channel 6 feet deep at mean low water and 100 to 150 feet wide, extending from the shore at Canarsie Landing to the navigable channel in Jamaica Bay, a distance of about 3,500 feet. It was thought that the channel might be maintained by the construction of two pile dikes, forming a tidal reservoir. The estimated cost under this project was $88,000.

A detailed history of the work will be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 637.

In regard to the portion of the contemplated improvement already completed, it should be stated that the main channel has been dredged to a width of from 100 to 125 feet and a depth of 6 feet at mean low water from Canarsie Landing to the deep water of Jamaica Bay, except for a short distance, where the width obtained was only 50 feet. In addition, two dikes, respectively 1,058 and 820 feet in length, have been built on the north and south sides of the present channel, at its entrance to the deep water of Jamaica Bay. The value of these dikes in maintaining the channel has not been thoroughly demonstrated, and no extension of them is therefore contemplated at present; they will, however, be kept in repair as far as possible.

There have also been several minor improvements not contemplated in the original project for the prosecution of which permission was in each case obtained from the Department. (See Report for 1889.) Among these should be mentioned a cut about 100 feet in length, 50 feet wide, and 6 feet deep on the east side of the steamboat landing at Canarsie for use as a turning basin; also a cut at the end of the wharf at Canarsie Landing, and its subsequent extension through to the southwest, to connect with the Southwest Channel. This latter cut has been quite successful in giving a better circulation of the tide through the main channel, although it has shoaled considerably.

An examination made during the latter part of May shows that the main channel has not deteriorated materially during the past winter.

A project for the expenditure of the $5,000 appropriated by the act of September 19, 1890, in continuing the improvement by dredging the main channel to a depth of 6 feet at mean low water, with a width of 125 feet throughout its length, was approved October 20, 1890.

Specifications were prepared and sealed proposals invited by advertisement under date of February 3, 1891, for widening and deepening the channel by dredging to a depth of 6 feet at mean low water and width of 125 feet where the depth is now from 3 to 6 feet. Bids were opened March 10, 1891, the lowest bidder being Elijah Brainard, at 24½ cents per cubic yard, scow measurement. [Abstract herewith.] The bid was approved, and a contract entered into March 20, 1891, for the removal of 13,000 cubic yards, more or less, of material. Work will be begun upon the completion of dredging at Shoal Harbor and Compton Creek, New Jersey, which was also awarded the same bidder and embraced in the same contract.

The mean tidal range is about 4.7 feet.

The commerce of the bay was reported in 1889 to be about 26,262 tons, valued at $449,250; this has increased to 50,898 tons, valued at $612,000, during 1890.

The expenditures during the past fiscal year amount to $202.37, as follows:

Advertising	$6.00
Surveying	86.34
Administration	110.03
Total	202.37

Canarsie Landing, besides being the terminus of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad, from which passengers are transhipped by steamer to Rockaway Beach, has a large fishing industry.

It is thought that $10,000 will be sufficient to complete the channel and repair the dikes, and an appropriation of this amount is therefore recommended.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1891, is $147,538,045.69.

Original estimate	$88,000.00
Amount appropriated	48,000.00
Amount expended	42,688.36

Money statement.

July 1, 1890, balance unexpended	$514.01
Amount appropriated by act approved September 19, 1890	5,000.00
	5,514.01
June 30, 1891, amount expended during fiscal year	202.37
June 1, 1891, balance unexpended	5,311.64
July 1, 1891, amount covered by uncompleted contracts	3,185.00
July 1, 1891, balance available	2,126.64
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving Canarsie Bay, New York, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard, measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid.
			Cubic yds.
Richard Parrott, Newburg, N. Y	$0.60	$3,600	6,000
Elijah Brainard, New York, N. Y*	.24½	3,600	14,700
Morris and Cumings Dredging Company, New York, Y. Y	.27	3,600	13,333

* Contract entered into March 20, 1891, for the removal of 13,000 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Canarsie Bay, New York, during the year ending December 31, 1890, were kindly furnished by Mr. William Warner, superintendent of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Fish	2,148	$150,000	Steam	4	5½	200
Coal	3,000	12,000	Sail	60	5½	10
Fertilizers	30,000	150,000	Yachts	75	3½	3
Oysters and clams	15,750	300,000				
Total	50,898	612,000		139		

The above table shows an increase of 24,636 tons over that reported for the year ending December 31, 1889.

F 3.

IMPROVEMENT OF SHEEPSHEAD BAY, NEW YORK.

Sheepshead Bay, Long Island, is a small tidal bay about 2 miles long, lying inside Coney Island, New York, and extending easterly from the village of Gravesend to Rockaway Inlet, into which it empties. Its width varies from 100 to 1,000 feet, and its depth from 0 to 10 feet at mean low water. The natural entrance is subject to progressive changes of position, due to the action of the waves on the sandy beaches.

The first survey, with a view to its improvement, of which we have any record, was made in 1879 by General Newton, whose report, dated February 7, 1879, may be found in the Annual Report of the Chief of Engineers for 1879, page 400. The plan of improvement proposed, which was based upon this survey, provided for diking the channel and connecting it with Rockaway Inlet, the estimated cost being $100,000.

A survey made in 1882 furnished data for two revised estimates of the cost, providing for an outlet from Sheepshead Bay into Dead Horse Inlet, instead of directly into Rockaway Inlet, as at first proposed. The first of these estimates, which included a system of dikes in addition to dredging, was given as $62,900; the second, omitting the dikes, as $34,200. Detailed statements of these estimates were given in my report for 1890, page 838. The second of these plans is the one that was adopted for the work.

The original project for the formation and maintenance of a dredged channel, 100 feet wide and 6 feet deep mean low water, was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, to connect with the channel of similar width and depth already existing at that point.

Under this project 27,025 cubic yards were dredged by Mr. M. H. Flannery, by private agreement, at 25 cents per cubic yard, measured in scows, giving a channel of the required width and depth 3,400 feet in length, extending from the town of Sheepshead toward the cut at Dead Horse Inlet. This channel, which was completed December 6, 1889, seems to have maintained itself in a very satisfactory manner.

Sheepshead Bay is a harbor of minor importance, and must so continue until the entrance can be improved by an expensive system of jetties. At present it is for the most part used as a haven for small oyster and clam boats, and for a large fleet of pleasure boats in the summer season. The utility of future appropriations must be judged of, therefore, by these facts.

The commerce of the bay was reported for the year 1889, to be 35,000 tons, valued at $1,828,800.

The expenditures for the fiscal year ending June 30, 1891, amount to $497.74, as follows:

Cost of drafting	$150.00
Cost of administration	347.74
Total	497.74

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1891, is $147,538,045.69.

Original estimate (1879)	$100,000.00
Revised estimate (1882)	34,200.00
Amount appropriated	26,000.00
Amount expended	25,784.26

Money statement.

July 1, 1890, balance unexpended	$713.48
June 30, 1891, amount expended during fiscal year	497.74
July 1, 1891, balance unexpended	215.74
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,200.00

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Sheepshead Bay, N. Y., during the year ending December 31, 1890, were kindly furnished by Hon. John Y. McKane, of Sheepshead Bay, N. Y.:

Articles.	Amount.	Value.	Vessels.	No.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Building material, pipe, bluestone, and flagging.	76,600	$1,780,000	Steam	400	5	100
			Sail	600	3	25
			Barges	100	5½	250
Fish, clams, etc	30,000	600,000	Rafts	75		
Total	106,600	2,380,000		1,175		

The above table shows an increase in the commerce of 71,600 tons over that reported for the year ending December 31, 1889.

F 4.

IMPROVEMENT OF ARTHUR KILL, NEW YORK AND NEW JERSEY.

A history of this improvement, which originated by special resolution of the Committee of Commerce in the Senate, is given in the Annual Report of the Chief of Engineers for 1889, Part I, page 819, and a further statement of the condemnation proceedings necessary for the acquirement of the land forming Steep Point, is given in my Annual Report for 1890, page 843.

The total amount expended upon this improvement to June 30, 1890, was $3,135.50. This expenditure includes the part purchase of a tugboat and the expenses incurred in the condemnation proceedings above alluded to, as well as certain administrative expenses of the office.

Operations under the contract of March 24, 1890, with Mr. R. G. Packard, were begun on April 9, and the contract completed May 20, 1890, 29,000 cubic yards having been removed. The resulting channel was thereby increased in width by 150 feet, with a minimum depth of 13 feet at mean low water. At the close of the fiscal year $6,815 was due the contractor, and this amount was carried on the last report as an outstanding liability. It was paid and the account settled July 17, 1890.

In the river and harbor act of September 19, 1890, an additional sum of $7,000 was appropriated for the continuance of this improvement, and a project for its expenditure was approved October 4, 1890. This project, as before, contemplates the removal of the land forming Steep Point by successive parallel cuts, until the appropriation is exhausted. Specifications were prepared and sealed proposals invited by advertisement, February 3, 1891, for the removal of the land in question, by dredging, to the depth of 13 feet at mean low water, where the depth is now from +6 feet to −13 feet at the same stage of the tide. Bids were opened March 10, the lowest bidder being the Atlantic Dredging Company of New York, at 24½ cents per cubic yard measured in the scow. [Abstract herewith.] This bid was approved, and a contract entered into March 21, 1891, for the removal of 22,400 cubic yards more or less of material. Operations under this contract were begun May 29, and continued without interruption to June 25, 22,000 cubic yards of material having been removed and deposited at sea, thus completing the contract.

On examining the map accompanying my last annual report, it will be seen that the result anticipated by the removal of the point has already begun to be felt. The flood threads, as indicated by the heavy lines, are in the neighborhood of the point, more nearly in a direction perpendicular to the Baltimore and Ohio Railroad Bridge than those indicated by the earlier survey, which are in dotted lines. As these surveys, although by different assistants, seem to have been conducted in each instance with great care, they probably give us an accurate relative measure of the changes thus far produced.

It is desirable that a further appropriation of $10,000 be made for the fiscal year ending June 30, 1893, as the funds already in hand will not be sufficient to complete the improvement and the favorable results thus far attained seem to warrant the ultimate completion of the project.

The expenditures for the fiscal year ending June 30, 1891, amount to $7,205.09, as follows:

Dredging under contract dated March 24, 1890	$6,815.00
Inspection	112.00
Drafting	6.24
Administration	271.85
Total	7,205.09

The commerce as reported for the year ending December 31, 1890, amounts to 6,945,604 tons, valued at $85,105,783.

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1891, is $147,538,045.69.

Original estimate	$26,500.00
Amount appropriated	17,000.00
Amount expended	10,340.59

Money statement.

July 1, 1890, balance unexpended	$6,864.50
Amount appropriated by act approved September 19, 1890	7,000.00
	13,864.50
June 30, 1891, amount expended during fiscal year	7,205.09
July 1, 1891, balance unexpended	6,659.41
July 1, 1891, outstanding liabilities	5,396.00
July 1, 1891, balance available	1,263.41
Amount (estimated) required for completion of existing project	9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893.	9,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for improving Arthur Kill between Staten Island and New Jersey, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
			Cubic yards.
Atlantic Dredging Company,* New York, N. Y	$0.24½	$5,500	22,450

*Contract entered into March 21, 1891, for the removal of 22,400 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Arthur Kill, New York and New Jersey, during the year ending December 31, 1890, were compiled from statements furnished by parties making shipments over this water-way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	4,188,896	$16,813,958	Steam	4,153	10	267
Building material	736,229	2,248,358	Sail	4,402	10	219
Iron and ores	61,270	2,133,185	Barges	17,528	10	332
Miscellaneous	1,959,209	63,910,282	Rafts	4,970		
Total	6,945,604	85,105,783		31,053		

The above table shows an increase in the commerce of 199,768 tons over that reported for the year ending December 31, 1889.

F 5.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

A description of this channel and a complete history of the work done toward its improvement may be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 743.

Thus far the improvement has been confined to that part of the channel, about 1¾ miles long, which lies to the east of Elizabethport, N. J., and at the mouth of Newark Bay. This originally had a depth of only 9½ feet at mean low water, while the remainder, lying between the shores of Staten Island and New Jersey, had a depth of from 14 to 40 feet at mean low water.

The first project for the improvement of this channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part, and protecting the cut by parallel dikes. The estimated cost of this was $443,210. Fifty thousand dollars of this amount, appropriated in 1874, was spent in 1874-'75 in the construction of 2,237 feet of the south dike, opposite Elizabethport.

Great opposition being made to this plan by oyster men and towboat men, it was decided to modify it, and the project was therefore changed in 1880 so as to dredge a channel 400 feet wide and 13 feet deep over the middle 200 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was $125,705. In addition to this it was proposed, should it be found necessary, to built four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was $60,000, bringing the total estimated cost of the proposed improvement up to $185,705. A modification of this project, having in view the total rejection of the dikes, was submitted May 9, 1889, and was approved May 15.

A further modification of the original project, necessitated by the increasing demands of commerce, and the one under which the present appropriation is being expended, was approved October 20, 1890. This project calls for a uniform channel depth of 14 feet at mean low water over the entire width of 400 feet.

The act of September 19, 1890, appropriated $15,000 for the further prosecution of this important work, and, under the project detailed in the preceding paragraph, specifications were prepared and sealed proposals invited by advertisement dated February 3, 1891, for widening and deepening the channel by dredging at the Corner Stake Light and opposite the mouth of Elizabeth River, New Jersey, to a depth of 14 feet mean low water, and width of 400 feet where the depths now vary from 4 to 14 feet. Bids were opened March 10, 1891, the lowest bidder being Thomas H. Benton, at 26 cents per cubic yard, scow measurement (abstract herewith). This bid was approved, and a contract entered into March 23, 1891, for the removal of 45,000 cubic yards, more or less, of material. Work under this contract was begun April 20, 1891, and continued without interuption to June 29, 44,820 cubic yards of material having been removed and deposited at sea, thus completing the contract.

The amount expended on this improvement to June 30, 1890, was $183,627.15.

The expenditures during the past fiscal year amount to $6,983.91, as follows:

Dredging	$5,771.38
Advertising	36.00
Inspection	386.53
Drafting	225.00
Administration	565.00
Total	6,983.91

The estimated amount required to complete the existing project is $61,000, of which $30,000 can be profitably expended during the fiscal year ending June 30, 1893.

From statistics compiled for the fiscal year ending June 30, 1887, the total shipping passing the Stake Light was shown to be 8,442,439 tons, valued at $67,539,512; this was increased during the year ending December 31, 1890, to 9,170,514 tons, valued at $144,684,133.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1891, $147,538,045.69.

Original estimate (1873)	$443,210.00
Revised estimate (1880)	185,705.00
Revised estimate (1883)	210,000.00
Amount appropriated	199,000.00
Amount expended	190,611.06

Money statement.

July 1, 1890, balance unexpended	$372.85
Amount appropriated by act approved September 19, 1890	15,000.00
	15,372.85
June 30, 1891, amount expended during fiscal year	6,983.91
July 1, 1891, balance unexpended	8,388.94
July 1, 1891, outstanding liabilities	5,891.32
July 1, 1891, balance available	2,497.62
Amount (estimated) required for completion of existing project	61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving channel between Staten Island and New Jersey, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid.
			cubic yds.
Thomas H. Benton,* Elizabeth, N. J	$0.26	$12,000	46,154
Elijah Brainard, New York, N. Y	.27½	12,000	43,636
Morris & Cumings Dredging Company, New York, N. Y	.28	12,000	42,857

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* Contracts entered into March 23, 1891, for the removal of 45,000 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of channel between Stat and New Jersey for the year ending December 31, 1890, were compiled fro ments furnished by parties making shipments over this water way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.
	Tons.				*Feet.*
Coal	4,885.297	$19,599,569	Steam	17,824	11
Building material	1,077,675	6,379,330	Sail	12,999	11
Iron and ores	331,919	17,109,310	Barges	14,504	12
Oils	130,000	1,400,000	Rafts	5,069	
Miscellaneous	2,745,623	100,195,931			
Total	9,170,514	144,684,140		50,306	

The above table shows an increase in the commerce of this water way of tons over that reported for the year ending December 31, 1890.

F 6.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY.

The Passaic River is being improved under two separate projects. first applying to the river below Centre Street Bridge, Newark and beyond the shoal in Newark Bay, a distance of 7⅝ miles; the sec to the upper course of the river from Centre Street Bridge as fa Passaic, a distance of 8 miles.

For various reasons, both scientific and economical, it is highly de able that these projects and accompanying appropriations should united in order that the funds may be expended at those points, treatment of which will best conduce to the regulation of the tidal p tion of the river in its entirety.

1. BELOW NEWARK.

The lower portion of the river from the Centre Street Bridge to Ne ark Bay was first surveyed by the Engineer Department in 1879. Th greatest depth in the channel at a point above the Elbow Beacon wa only 7.1 feet, and in many places the greatest depth was 7.5 feet a mean low water. A project was adopted, based on this survey, providing for obtaining, by diking and dredging, a channel 200 feet wide an 10 feet deep at mean low water from Centre Street Bridge to Newar Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbo act of that year, providing for extending the dike at the mouth of the river into the bay a distance of 12,000 feet and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1890, was $198,258.27, with which 6,205 feet of dike was built, the channel through the shoal in the bay, also the channel up the river to and 1,423 feet beyond the Newark and New York Railroad Bridge, dredged to the full dimensions as required by the adopted project; thence for a distance of 1,150 feet upstream was redredged and given a width of 180 feet, and from this point to Lister Dock was regulated to a width of 100 feet, with a uniform depth of 10 feet at mean low water throughout. A recent survey of the portion of the river dredged by the appropriation of August 11, 1888, as detailed in my last report, shows that the depths have been maintained unexpectedly well during the past winter.

An appropriation of $40,000 was made in the act of September 19, 1890, and a project for its expenditure in widening and deepening the channel to the required dimensions and in enlarging the channel width within the populous districts of the city of Newark to the full width of the stream, upon the urgent desire of the riparian owners, was approved October 4, 1890.

Specifications were prepared and sealed proposals invited by advertisement, dated February 3, 1891, for improving the channel between Centre Street Bridge and the Toll Bridge to a width of 200 feet and depth of 10 feet, mean low water, where the depth is now from 8 to 10 feet, by dredging. Bids were opened March 10, 1891, the lowest bidder being R. G. Packard, at 30 cents per cubic yard, scow measuremen (abstract herewith). This bid was approved and a contract entered into March 21, 1891, for the removal of 110,000 cubic yards, more or less, of material. Work had not yet been begun at the close of the fiscal year, but assurance had been given of its commencement early in July.

By Department letter of March 3, 1891, I was directed to supervise the construction of a bridge about to be built by the Jersey City, Newark and Western Railroad Company across Newark Bay, so far as it may be necessary in order that it be built in accordance with the approved plans, reporting to the Chief of Engineers at the proper time whether the bridge is so constructed. This supervision has been exercised from time to time, as well as that of the dike at Newark Bay, temporarily occupied by the Messrs. Shanley, contractors. There is no report unfavorable to the Government to make at present.

The expenditures for the fiscal year amount to $1,928.58, as follows:

Drafting	$450.00
Surveying	579.77
Administration	898.81
Total	1,928.58

The estimated amount necessary to complete the existing project is $114,375, and of this it is estimated that $75,000 can be profitably expended during the fiscal year ending June 30, 1893.

The commerce of this stream, as reported for the year ending December 31, 1890, is 1,484,045 tons, valued at $49,195,025. Thirty thousand two hundred and twenty-four vessels passed through the draw at the mouth of the river during the same period, as against 27,036 in 1889.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at lower end of the dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected at the port of Newark, N. J., during the fiscal year ending June 30, 1891, is $4,118.94.

Original estimate (1879)	$232,875.00
Revised estimate (1884)	353'875.00
Amount appropriated	239,500.00
Amount expended	200,186.85

Money statement.

July 1, 1890, balance unexpended	$1,241.73
Amount appropriated by act approved September 19, 1890	40,000.00
	41,241.73
June 30, 1891, amount expended during fiscal year	1,928.58
July 1, 1891, balance unexpended	39,313.15
July 1, 1891, amount covered by uncompleted contracts	33,000.00
July 1, 1891, balance available	6,313.15
Amount (estimated) required for completion of existing project	114,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	75,000.000
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving Passaic River, New Jersey, below Newark, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	Cents.		*Cubic yards.*
P. Sanford Ross, Jersey City, N. J.	.32	$34,000	106,250
R. G. Packard, New York City, N. Y.*	.30	34,000	113,333

* Contract entered into March 21, 1891, for the removal of 110,000 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to commerce of Passaic River, New Jersey, below Newark, were kindly furnished by Hon. P. T. Quinn, secretary of the board of trade, Newark, N. J., for the year ending December 31, 1890:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	233,901	$935,604	Steam	13,498	9	475
Fertilizers	332,750	11,094,073	Sail	8,255	8	200
Ice	157,300	629,200	Barges	6,458	6	200
Iron and ores	215,380	10,769,000	Rafts	99		
Building material	322,646	3,986,972				
Grain	24,068	770,176				
Miscellaneous	198,000	21,010,000				
Total	1,484,045	49,195,025		28,310		

The above table shows an increase of 144,050 tons over that reported for the year ending December 31, 1889.

2. ABOVE NEWARK.

Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford Park, and Holzman Bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across and above the shoals from 7½ to 6 feet deep at mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad Bridge, increasing the estimate to $129,000, which was further increased in 1886 to $133,762. The deposit of material from freshets, as well as the difficult and costly nature of the dredging, prompted a recommendation to increase this last estimate to $193,822, which was approved October 6, 1890.

Under this project $129,702.28 had been expended to June 30, 1890, and channels of the requisite depth had been dredged from 60 to 75 feet wide, excepting for a distance of 1,500 feet above the Erie Railroad Bridge. Of the above amount $3,254.25 was expended from the appropriation for the improvement as its pro rata share of a dredging plant, which consists of 1 dipper dredge, 3 dump scows, and 1 tugboat, purchased for this district at a total cost of $44,690.

The act of September 19, 1890, appropriated $5,100 to be expended upon this improvement. The wording of the act was as follows:

> Improving Passaic River above Newark, N. J.: Continuing improvement, five thousand one hundred dollars, one thousand five hundred dollars of which, or so much thereof as may be necessary, shall be expended in making an examination and survey of said river.

A project for the expenditure of this appropriation in the removal of Third River Bar, by dredging a channel 100 feet wide and 6 feet deep for a distance of about 1,600 feet, and in the removal of bowlders at various points in the river, in response to several complaints, was approved October 6, 1890.

For the reason that a detailed survey of the river had already been made and paid for from the funds then in hand (see Annual Report for 1890, page 848) before the passage of the act of September 19, 1890, it was recommended that the entire $1,500, set apart by the act for this purpose, be devoted to the actual work of improvement. This was also approved October 6, 1890.

Specifications were prepared and sealed proposals invited by advertisement dated February 3, 1891, for widening and deepening the channel opposite Rose Park one-half mile above Avondale, by dredging to a depth of 6 feet mean low water and width of 100 feet, where the depth is now from 4 to 6 feet. Bids were opened March 10, 1891, the lowest bidder being Richard Parrott, at 35 cents per cubic yard, scow measurement (abstract herewith). This bid was approved and a contract entered into March 23, 1891, for the removal of 13,000 cubic yards, more or less, of material. At the close of the fiscal year work had not yet been begun.

The expenditures during the fiscal year ending June 30, 1891, were $432.39, as folows:

Drafting	$150.00
Administration	282.39
Total	432.39

The commerce, although by no means as extensive as that of the lower portion of the river, appears to be increasing rapidly; this was reported for the calendar year 1889 to be 315,437 tons, valued at $2,545,077.

The estimated amount required to complete the existing project is $54,972, $20,000 of which could advantageously be expended during the fiscal year ending June 30, 1893.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1891, $4,118.94.

Original estimate (1872)	$123, 924. 00
Revised estimate (1886)	133, 762, 00
Revised estimate (1890)	193, 822. 00
Amount appropriated	138. 850. 00
Amount expended	130, 134. 67

Money statement.

July 1, 1890, balance unexpended	$4, 047. 72
Amount appropriated by act approved September 19, 1890	5, 100. 00
	9, 147. 72
June 30, 1891, amount expended during fiscal year	432. 39
July 1, 1891, balance unexpended	8, 715. 33
July 1, 1891 amount covered by uncompleted contracts	4, 550. 00
July 1, 1891, balance available	4, 165. 33
Amount (estimated) required for completion of existing project	54, 972. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for improving Passaic River, New Jersey, above Newark, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard, measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	Cents.		*Cubic yards.*
Richard Parrott, Newburg, N. Y*	35	$8, 000	22, 857
Elijah Brainard, New York, N. Y	48½	8, 000	16, 495
Morris & Cumings Dredging Company, New York, N. Y	58	8, 000	13, 800

* Contract entered into March 23, 1891, for the removal of 13,000 cubic yards, more or less, of material

COMMERCIAL STATISTICS.

The following statistics relative to commerce of Passaic River, New Jersey, above Newark, during the year ending December 31, 1890, were compiled from statements furnished by parties making shipments over this stream:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Iron	3, 845	$197, 615	Steam	280	8	212
Building material	165, 843	1, 940, 664	Sail	297	9	231
Coal	92, 190	348, 135	Barges	541	7	200
Miscellaneous	17, 722	712, 580	Canal boats.	515	7	161
Total	279, 600	3, 198, 994	....	1, 633	....	....

The above table shows a decrease in the commerce of 35,837 tons, compared with that reported for 1889. This decrease is only apparent, however, as many of the parties who replied to letters of inquiry last year have failed to do so this year.

Twelve thousand two hundred and four vessels passed the draw of the Centre Street Bridge during the year 1890.

F 7.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

This stream, which is 2⅝ miles in length from its mouth to the head of navigation, at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet. Its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining by dredging a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation at an estimated cost of $25,530. The estimated cost, under the project of 1878, was increased in 1882 to $43,160, the increase being due to advanced prices.

The total amount expended to June 30, 1890, was $27,000, and a channel was in 1883 dredged with the required depth to within 1,000 feet of the Broad Street Bridge, which somewhat increased the commerce of the creek. This channel has, however, since become almost obliterated because of large deposits of silt and sewage refuse.

The act of September 19, 1890, appropriated $5,000 for the continuance of this improvement, the first allotment since 1882, and a project for dredging the channel as far as possible to the full dimensions required by the original project was approved October 20, 1890.

Specifications were prepared and sealed proposals invited by advertisement dated February 3, 1891, for dredging the channel between the town of Elizabeth and Staten Island Sound to a depth of 7 feet mean high water where the depth is now from 3 to 7 feet at mean high water, with a width of 60 feet. Bids were opened March 10, 1891, the lowest bidder being Richard Parrott, at 55 cents per cubic yard, measured in scows (abstract herewith). This bid was approved, and a contract entered into March 23, 1891, for the removal of 7,000 cubic yards, more or less, of material. Work had just been begun at the close of the fiscal year.

The citizens of the city of Elizabeth have recently been very active in devising schemes for a more radical amelioration of the present conditions. The most promising plan is to rectify the creek, converting it into a regular canal, with a lock to be situated at a point between the lower limits of the town and Arthur Kill, and a dam further up the river to control the freshet water. This would undoubtedly be an excellent plan, but aside from the question of expense, which would be greatly out of proportion to the probable benefits, it would not be practicable unless the sewage of the city be collected by an intercepting sewer, and discharged below the lock. At present all the sewage flows into the creek along the city front, and even under the existing ebb and flow of the tide is already becoming a menace to the health of the inhabitants. If this creek became slack water by the building of the lock, the conditions would be still more unbearable.

If it is the intention of Congress to complete this improvement the balance of the estimate, $11,160, could be expended profitably as regards the efficient prosecution of the work under the original project during the fiscal year ending June 30, 1893, and would be applied to dredging the channel to the full dimensions.

The estimated amount required for the completion of the improvement is $11,160.

Elizabeth River is in the collection district of Newark, N. J. Nearest light-house, Bergen Point Light. Nearest fort, Fort Tompkins.

Amount of revenue collected at the port of Newark during the fiscal year ending June 30, 1891, is $4,118.94.

Original estimate (1878)	$25,530
Revised estimate (1882)	43,160
Amount appropriated	32,000
Amount expended	27,265

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	265.00
July 1, 1891, balance unexpended	4,735.00
July 1, 1891, amount covered by uncompleted contracts	3,850.00
July 1, 1891, balance available	885.00
Amount (estimated) required for completion of existing project	11,160.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,160.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for improving Elizabeth River, New Jersey, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	Cents.		*Cubic yard.*
Edgar M. Payn, Albany, N. Y	59	$4,000	6,780
Richard Parrott, Newburg, N. Y.*	55	4,000	7,273
James McSpirit, Jersey City, N. J	74	4,000	5,405
Elijah Brainard, New York, N. Y	75	4,000	5,333

* Contract entered into March 23, 1891, for the removal of 7,000 cubic yards, more or less, of material

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Elizabeth River, New Jersey, during the year ending December 31, 1890, were kindly furnished by Mr. Thomas H. Benton, of Elizabethport, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal and coke	8,700	38,500	Steam	1	8	152
Rope, hemp, etc	10,500	2,500,000	Sail	80	7	100
Building material	21,100	174,000	Barges	255	6	150
Miscellaneous	40	3,200				
Total	40,340	2,715,700		336		

The above table shows an increase in the commerce of 890 tons over that reported for the year ending December 31, 1889.

F 8.

IMPROVEMENT OF RAHWAY RIVER, NEW JERSEY.

In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3⅝ miles; 7 feet at Edgar's Dock, 4½ miles; 4.4 feet to Milton Avenue Bridge, 4¾ miles; and 4 feet to Main Street Bridge, 5 miles in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge, and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

To June 30, 1890, $37,000 had been expended under this project, which had resulted in the formation of a channel 7 feet deep at high water and from 100 to 50 feet in width to within 550 feet of the head of navigation. It has not, however, proved permanent.

The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the river.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The condition of the river has deteriorated since the work was suspended and its commerce has decreased, the shoaling of the river having obliged one of the principal shippers to transfer his business to the railroad.

If it is the intention of Congress to complete this improvement, the balance of the estimate, $29,250, could be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1893, and would be applied to deepening and widening the channel by dredging.

The estimated amount required for the completion of the improvement in accordance with the approved project is $29,250.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. The nearest light-house is Princess Bay Light, and Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1891, at the port of Perth Amboy, N. J., is $16,592.09.

Original estimate (1878)	$36,653
Revised estimate (1882)	66,250
Amount appropriated	37,000
Amount expended	37,000

COMMERCIAL STATISTICS.

There has been no change in the commerce of this stream during the year ending December 31, 1890. See Annual Report of the Chief of Engineers, Part I, page 854, for fiscal year ending June 30, 1890.

Money statement.

Amount (estimated) required for completion of existing project	$29,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	29,250.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

F 9.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

Before its improvement by the United States, the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead Sand Dock, 8½ miles; and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 feet to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brickyards on the South River, had an extensive commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874, and provides for obtaining, by diking and dredging, and, where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep at mean low water, from the mouth to New Brunswick, at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the south channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearney's Dock to Crab Island.

Under this project $510,685.39 had been expended June 30, 1890, in constructing the dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, in drilling, blasting, and dredging a channel of the same dimensions across the rocky shoals at Whitehead Sand Dock, and thence up the river, with a width of 100 feet and a depth of 10 feet, to within 1 mile of New Brunswick. Under the two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements had been of great benefit to navigation, permitting the large tows in use on the river to reach a point 4 miles below New Brunswick at all stages of the tide. The commerce of the river was reported in 1887 at 1,675,355 tons, valued at $28,119,173, and in 1889 at 1,651,464 tons, valued at $25,507,194; during the past year it is reported to be 1,661,425 tons, valued at $29,877,365.

The gradual falling off in the commerce from the much larger figure given above for 1871 is due to the purchase and partial disuse of the Delaware and Raritan Canal by the Pennsylvania Railroad, but it is thought that the excavation of a 10-foot channel to the canal locks will stimulate local manufacture to an extent which will much more than offset the loss of commerce from this source.

During the past fiscal year the Government plant, consisting of a dredge, three scows, tug-boat, and additional hired tug, has been employed constantly, except between December 2, 1890, and April 8, 1891, when the plant was in winter quarters, in carrying the preliminary 100-foot section of the channel toward New Brunswick. Much of the digging has been extremely severe, consisting of more or less compact shale rock. The new dipper, of smaller size and stronger structure, mentioned in my last annual report, has been of great service, but during the month of June, just past, the rock became so hard that it could not be torn apart by this means, and resort was had to surface blasting with good effect. Hereafter, blasting will precede the dredging throughout the rocky section, and progress will necessarily be slow. The progress made during the past fiscal year has resulted in an additional length of 4,300 feet, bringing the 100-foot channel to within 2,800 feet of the canal lock;

this includes a section of 570 feet at Fox Gully, excavated during the preceding year, as detailed in my last report.

The following table will give items of cost, etc., and relates only to the work performed during the past fiscal year:

Month.	Total number of working days.	Actual time (days).		Average amount dredged per actual working day.	Amount dredged and deposited.			Expenses.		Total cost of dredging and depositing per cubic yard.	Total cost per cubic yard, including interest on original cost of plant.*
		Worked.	Lost.		Sand, mud, and gravel.	Shale rock.	Total.	Operating, including maintenance while idle.	Repairs and additions.		
1890.				*Cu. yds.*	*C.yds.*	*C.yds.*	*C.yds.*				
July	26	19	7	423	6,669	1,450	8,119	$1,600.83	$1,064.38	$0.328	$0.347
August	26	24½	1½	229	1,872	3,748	5,620	1,315.80	53.61	0.244	0.270
September	26	21	5	545	11,387	....	11,387	1,849.41	26.27	0.165	0.178
October	27	24½	2½	494	12,163	....	12,163	1,770.37	61.10	0.150	0.163
November	23	16½	6½	490	8,005	....	8,005	1,839.97	119.81	0.245	0.263
December	26	1½	24½	396	495	....	495	570.38	....	....	....
1891.											
January	26	......	26	....	....	....	....	145.00	....	....	....
February	23	......	23	....	....	....	....	154.36	89.52	....	....
March	26	......	26	....	....	....	....	145.00	2,406.48	....	....
April	25	16	9	495	7,363	560	7,923	1,714.63	129.25	0.233	0.251
May	25	19½	5½	631	11,599	709	12,308	1,820.45	16.12	0.150	0.161
June	26	17½	8½	239	3,381	739	4,120	1,697.96	184.07	0.457	0.493
Totals and averages	305	160	145	438	62,934	7,206	†70,140	14,624.16	4,150.61	0.268	0.293
								18,774.77			

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* Interest computed at 4 per cent.

† The lowest contractor's bid received in 1887 for the work to be done in this locality and of similar character was: For sand and gravel, 43 cents per cubic yard; for shale and rock, $3.50 per cubic yard. (See Annual Report, 1888.) The amount of material removed as per above table, taken at contractor's prices, would show a saving for the fiscal year of $33,507.85.

In order to determine if possible the efficiency of the felting of the boilers in saving of fuel, I submit the following tables relating to the coal consumption for the working season of 1889 (boilers uncovered) and 1890 (boilers covered):

DREDGE ALPHA.

Season.	Days worked.	Total coal consumed.	Average consumption per working day.	Total removed.	Average coal consumption per cubic yard.
		Tons.	*Tons.*	*Cu. yds.*	*Pounds.*
1889	164	263.28	1.6	55,805	9.41
1890	184	261.58	1.42	66,358	7.86

TUGBOAT MARY.

Season.	Days worked.	Total coal consumption.	Total miles of towing.	Mean distance towed per day.	Coal consumed per mile of towing.
		Tons.		*Miles.*	*Pounds.*
1889	164	238.51	521.52	3.18	914
1890	184	305.53	1,262.24	6.86	484

In regard to the second of these tables it should be stated that the tows were nearly identical in average weight during both seasons. The saving is therefore apparently much greater in the case of the tugboat than in that of the dredge, although there are some elements which tend to modify the result in the former case which can not be well considered; such, for instance, as the general velocity and direction of the tidal flow during the towing. This would probably introduce a slightly different factor for two seasons, as much of the work during the season of 1889 was done in the Shrewsbury River, while all of that for 1890 was in the Raritan.

On April 9, 1891, the drill scow previously borne on my property returns for this improvement was transferred to Lieut. Col. G. L. Gillespie.

The river and harbor act of September 19, 1890, made an appropriation of $50,000 for this improvement, which is being expended as above detailed under project approved October 4, 1890.

The expenditures during the fiscal year amount to $23,521.19, as follows:

Dredging, including operating expenses, repairs, etc	$17, 386. 97
Repairing dikes at Middle Grounds	1, 398. 12
Wharfage of drill scow	101. 00
Surveying	474. 68
Drafting	300. 00
Inspection	2, 127. 13
Administration	1, 733. 29
Total	23, 521. 19

The amount which can be expended profitably, as regards the efficient prosecution of the work during the fiscal year ending June 30, 1893, is $100,000, and if appropriated will be expended in carrying the improved channel farther up the river toward New Brunswick.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1891, $16,592.09.

Original estimate	$2, 093, 662. 05
Amount appropriated	571, 250. 00
Amount expended	534, 206. 58

Money statement.

July 1, 1890, balance unexpended	$10, 564. 61
Amount appropriated by act approved September 19, 1890	50, 000. 00
	60, 564. 61
June 30, 1891, amount expended during fiscal year	23, 521. 19
July 1, 1891, balance unexpended	37, 043. 42
July 1, 1891, outstanding liabilities	2, 474. 72
July 1, 1891, balance available	34, 568. 70
Amount (estimated) required for completion of existing project	1, 522, 412. 05
Amount that can be profitably expended in fiscal year ending June 30, 1893	100, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Raritan River, New Jersey, during the year ending December 31, 1890, were compiled from statements furnished by parties making shipments over the stream:

Articles.	Amount.	Value.	Vessels.	Number.	Average drafts.	Average tonnage.
	Tons.				*Feet.*	
Building material	718,103	$2,068,358	Steam	1,502	6	156
Coal	541,594	2,177,230	Sail	3,618	8	125
Iron and ores	56,265	1,631,685	Barges	9,107	7	175
Miscellaneous	345,463	24,000,092	Rafts	225	....	....
Total	1,661,425	29,877,365	....	14,452	....	....

The above table shows an increase in the commerce of 9,961 tons over that reported for the year ending December 31, 1889.

F 10.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

Before the improvement of this stream was undertaken by the United States the navigation of the lower 2½ miles of its course had been abandoned, and a canal dredged at private expense from a short distance below Washington to Sayreville, on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of this canal, on account of its faulty location, had shoaled to a depth of 6.4 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissetts, 3⅝ miles, and 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville. The range of the tide was 5.3 feet at Sayreville. The town of Washington and numerous brickyards did a commerce on the river valued at $1,249,000.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining, by diking and dredging, a depth of 8 feet mean low water to Washington, 6 feet to Bissetts, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow. It is estimated to cost $194,695. There is no present prospect of closing the old mouth of the river, as it is strenuously opposed by the inhabitants, who issue injunctions whenever an attempt is made to place material in that part of the channel. That portion of the project which contemplates cutting across the meadow is also held in abeyance for the present because of many obstacles.

An appropriation of $5,000 was made in the act of September 19, 1890. A project for the expenditure of this appropriation, continuing the improvement by means of dredging, in rectifying and widening the channel near the Raritan River Railroad Company's Bridge, at the sharp bend near Washington, and at Rourke Reach, about 1 mile above Washington, was approved October 20, 1890.

Specifications were prepared, and sealed proposals invited by advertisement, dated February 3, 1891, for improving the channel by dredging, in widening the approaches to the draw of the Raritan River Railroad Company's Bridge, giving a depth of 4 feet at mean low water where the depth is now from 0 to 4 feet; in widening the channel at the bend below Washington, giving a depth of 8 feet at mean low water where the present depth varies from 2 to 8 feet; and in dredging a channel through the bar in Rourke Reach to a depth of 6 feet, at mean low water, where the depth varies from 4 to 6 feet. Bids were opened March 10, 1891, the lowest bidder being Edgar M. Payn, at 38⅞ cents per cubic yard, scow measurement (abstract herewith). This bid was approved and a contract entered into March 24, 1891, for the removal of 12,000 cubic yards, more or less, of material. Work under this contract was begun May 25 and carried on continuously to the close of the fiscal year, 8,842 cubic yards having been removed.

An examination of the work done in the neighborhood of the railroad bridge, made by Mr. C. S. Kelsey, on June 18, gives the following information:

The dredging at the Raritan River Railroad Bridge, over South River, proves on examination to have been done as directed, and is of decided assistance to vessels in passing the draw.

Below the bridge for a distance of 350 feet the channel was widened on the west side by a cut 25 feet wide and about 5 feet deep mean low water; above the bridge, for an equal distance, the width was increased by cuts 25 feet and 45 feet wide. This improvement by cutting away the bank, which bent around in front of the draw-opening both above and below the bridge, gives a straight stretch of good water in front of the draw for a considerable distance on either side.

The draw-tender, Mr. French, stated that the increased ease with which vessels now pass the draw was readily seen.

The foreman of a new brickyard above the bridge reported that his sailing masters all considered the work a benefit, and that the draw was now much easier of navigation than that of the turnpike bridge just below.

The physical changes which take place in this river appear to be very slow, and the dredging is therefore of more or less permanent value.

The expenditures during the fiscal year amount to $374, as follows:

Inspection	$116.67
Drafting	150.00
Administration	107.33
Total	374.00

The sum of $30,000 can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1893. It would be applied to giving the channel the full dimensions required by the project.

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Great Beds Light, in Raritan Bay, N. J.; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1891, $16,592.09.

Original estimate	$194,695.00
Amount appropriated	71,000.00
Amount expended	64,400.42

Money statement.

July 1, 1890, balance unexpended	$1,973.58
Amount appropriated by act approved September 19, 1890	5,000.00
	6,973.58
June 30, 1891, amount expended during fiscal year	374.00
July 1, 1891, balance unexpended	6,599.58
July 1, 1891, amount covered by uncompleted contracts	4,665.00
July 1, 1891, balance available	1,934.58
Amount (estimated) required for completion of existing project	123,695.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for improving South River, New Jersey, by dredging, received, and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard, measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	Cents.		*Cu. yds.*
Edgar M. Payn, Albany, N. Y.*	38⅞	$5,000	12,862
Richard Parrott, Newburg, N. Y.	60	5,000	8,333
Elijah Brainard, New York, N. Y.	44½	5,000	11,236
Morris & Cumings Dredging Company, New York, N. Y.	46	5,000	10,870

*Contract entered into March 24, 1891, for the removal of 12,000 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of South River, New Jersey, during the year ending December 31, 1890, were kindly furnished by Capt. Luther Adams, New Brunswick, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Building material	833,600	$797,816	Steam			
Coal and wood	21,054	95,300	Sail	3,325	6	70
Fertilizers	8,000	22,760	Barges	3,805	6	98
Miscellaneous	1,500	135,325				
Total	864,154	1,051,201		7,130		

The above table shows an increase in the commerce of this stream of 53,804 tons over that reported for the year 1889.

F II.

IMPROVEMENT OF KEYPORT HARBOR, NEW JERSEY.

Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet, and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873, and provides for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steamboat dock to the 8-foot contour in Raritan Bay, at an estimated cost of $30,475.

The amount expended under this project to June 30, 1890, was $30,475, with which a channel had been dredged from the 8-foot curve in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet, and 160 feet for the remainder.

The commerce of the harbor had increased greatly, being estimated at $5,000,000, besides 150,000 passengers carried annually.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The dredged channel is stated to have shoaled in places to about 6 feet, mean low water, but it is reported that the commerce as yet shows no falling off.

If it is the intention of Congress to complete this improvement, the balance of the estimate, $10,000, can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1893, and would be applied to dredging the channel to the dimensions required by the project, which would add materially to existing facilities.

The estimated amount required for the completion of the improvement is $10,000.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1891, $16,592.09.

Original estimate (1873)	$30,475
Revised estimate (1884)	40,475
Amount appropriated	30,475
Amount expended	30,475

Money statement.

Amount (estimated) required for completion of existing project	$10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Keyport Harbor, New Jersey, during the year ending December 31, 1890, were compiled from statements furnished by parties making shipments over this water way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Produce	105,105	$4,532,875	Steam	4	6	365
Building material	80,950	449,500	Sail	82	6	95
Fertilizers	31,000	155,000	Barges	97	6	185
Coal	4,550	18,300				
Miscellaneous	1,360	103,000				
Total	222,965	5,258,675		183		

Increase in tons over that reported for year 1889, 53,823.

F 12.

IMPROVEMENT OF MATTAWAN CREEK, NEW JERSEY.

Before its improvement by the Government this small stream was obstructed at its entrance into Keyport Harbor by a mud flat on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-foot channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth, and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock 600 feet above and 1¼ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties it carried commerce valued in 1880 at $800,000. In 1885 the commerce of the creek was stated to be 130,000 tons, valued at $2,000,000. It has since increased to 187,850 tons, valued at $2,463,200.

The project for the improvement was adopted in 1881, and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

To June 30, 1890, the amount expended under this project was $21,000, with which a channel had been dredged, giving the required depth from the mouth to the freight dock at Mattawan, with widths varying from 100 to 30 feet.

There had been no appropriation for this stream since 1882 until the present appropriation of $2,500 was made in the act of September 19, 1890.

A project for the expenditure of this appropriation in dredging the channel to the full width and depth required by the project was approved October 9, 1890.

Specifications were prepared and sealed proposals invited by advertisement, dated February 3, 1891, for dredging a channel through a bar at the mouth of the creek to a depth of 4 feet at mean low water, where the depth is now from 2 to 4 feet at mean low water. Bids were opened March 10, 1891, the lowest bidder being the Atlantic Dredging Company, at 37½ cents per cubic yard, scow measurement [abstract herewith]. This bid was approved and a contract entered into March 21, 1891, for the removal of 5,300 cubic yards, more or less, of material. Work will be begun upon the completion of dredging in the Arthur Kill, as both works were awarded the same contractor and are included under one contract.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1891, $16,592.09.

Original estimate	$33,120
Amount appropriated	23,500
Amount expended	21,000

Money statement.

Amount appropriated by act approved September 19, 1890	$2,500.00
July 1, 1891, balance unexpended	2,500.00
July 1, 1891, amount covered by uncompleted contracts	1,987.50
July 1, 1891, balance available	512.50

Amount (estimated) required for completion of existing project	$9,620.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	9,620.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving Mattawan Creek, New Jersey, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard measured in scows.	Amount available for dredging.	Amount that can be removed for price bid per cubic yard.
	Cents.		*Cu. yds.*
Richard Parrott, Newburg, N. Y	65	$2,000	3,077
James McSpirit, Jersey City, N. J	45	2,000	4,444
Elijah Brainard, New York, N. Y	46	2,000	4,338
Atlantic Dredging Company, New York, N. Y.*	37½	2,000	5,306

* Contract entered into March 21, 1891, for the removal of 5,300 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics, relative to the commerce of Mattawan Creek, New Jersey, during the year ending December 31, 1890, were kindly furnished by Mr. J. W. Maggs, of Mattawan, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Produce	73,000	$1,825,000	Steam	2	6½	228
Brick	70,000	280,000	Sail	79	5	75
Fertilizers	31,000	155,000	Barges	88	5	150
Lumber	10,000	100,000				
Coal and wood	2,550	6,200				
Miscellaneous	1,300	97,000				
Total	187,850	2,463,200		169		

The above table shows an increase in the commerce of 57,850 tons over that reported for the calendar year 1887.

F 13.

IMPROVEMENT OF SHOAL HARBOR AND COMPTON CREEK, NEW JERSEY.

Shoal Harbor is situated on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River, New Jersey. The harbor is formed by a slight indentation in the shore line where Compton Creek empties into the bay. The outer harbor is unprotected by projecting headlands or other natural topographical features. The creek is used principally as a harbor for small vessels engaged in the fish and oyster trade and contains ample depth of water for this purpose, except at the entrance, which nearly runs dry at low water, thus preventing vessels from entering, excepting at or near high water.

At a point about one-quarter of a mile above its mouth the creek is crossed by a fixed bridge without a draw, beyond which no vessels ever go. The village of Port Monmouth, located on the left shore of the harbor, is the principal shipping point for garden truck from the adjacent farming districts and for fish and oysters taken in the bay. These products are shipped directly to New York City markets, mostly by a steamboat, drawing about 4 feet of water, making daily trips between these points. About 100 sloops of from 15 to 20 tons burden are engaged in the fish and oyster trade and find shelter during stormy weather in the lower reaches of Compton Creek, whenever they can enter the same. Its present commerce is reported to be 35,500 tons, mainly farm produce, clams, and oysters.

The first survey, with a view to its improvement, was made in 1883, by Lieut. Col. G. L. Gillespie, Corps of Engineers, whose report, dated January 7, 1884, may be found in the Annual Report of the Chief of Engineers for 1884, Part I, page 770.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek on the inside with the 5-foot curve of the bay by means of a dredged channel 150 feet wide, and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

The first appropriation was made in the recent act of September 19, 1890, the wording being as follows: "Improving Shoal Harbor and Compton Creek, New Jersey, so as to give a channel 4 feet deep at mean low water, $5,000." A project for its expenditure in dredging, with the object of obtaining a 4-foot channel in lieu of the 5-foot channel as projected above, was approved October 9, 1890. It is not the present intention to build the dike unless this shall be found essential to the maintenance of the channel.

Specifications were prepared and sealed proposals invited by advertisement dated February 3, 1891, for dredging a channel from the mouth of Compton Creek toward Raritan Bay, as far as the funds available will permit, to a depth of 4 feet mean low water where the depths vary from 0 to 4 feet at mean low water. Bids were opened March 10, 1891, the lowest bidder being Elijah Brainard, at 24¾ cents per cubic yard, scow measurement [abstract herewith]. This bid was approved and a contract entered into March 20, 1891, for the removal of 16,000 cubic yards, more or less, of material. Work under this contract was begun April 25, 1891, the amount of material removed to the close of the fiscal year being 10,808 cubic yards, resulting in a channel improved to a depth of 4 feet mean low water, with a width of 70 feet, for a distance of 980 feet from the steamboat dock.

The expenditures during the fiscal year amount to $1,649.80, as follows:

Dredging under contract	$1,201.07
Inspection	223.33
Drafting	8.25
Administration	217.15
Total	1,649.80

The sum of $10,000 can be utilized profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1893. It would be expended in giving the channel the full dimensions required by the project.

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light; and nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1891, $16,592.09.

Original estimate	$64, 130. 00
Amount appropriated	5, 000. 00
Amount expended	1, 649. 80

Money statement.

Amount appropriated by act approved September 19, 1890	$5, 000. 00
June 30, 1891, amount expended during fiscal year	1, 649. 80
July 1, 1891, balance unexpended	3, 350. 20
July 1, 1891, amount covered by uncompleted contracts	2, 758. 93
July 1, 1891, balance available	591. 27
Amount (estimated) required for completion of existing project	59, 130. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of bids for improving Shoal Harbor and Compton Creek, New Jersey, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard, measured in scows.	Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	Cents.		*Cubic yards.*
Richard Parrott, Newburg, N. Y.	60	$4, 000	6, 667
Elijah Brainard, New York, N. Y.*	24¾	4, 000	16, 161
Morris & Cumings Dredging Company, New York, N. Y.	45	4, 000	8, 888

*Contract entered into March 20, 1891, for the removal of 16,000 cubic yards, more or less, of material.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Shoal Harbor and Compton Creek, New Jersey, during the year ending December 31, 1890, were kindly furnished by Capt. Benjamin Griggs, of Port Monmouth, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Produce and coal	25, 000	$75, 000	Steam	2	4	496
Clams and fish	4, 000	8, 000	Sail	100	2	20
Manure and limestone	5, 900	11, 300				
Miscellaneous	600	12, 000				
Total	35, 500	106, 300		102		

The above table shows an increase in the commerce of about 10,500 tons over that reported in 1884.

F 14.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

The project for this improvement was adopted in 1879, and contemplates the formation of a channel 6 feet deep at mean low water and from 300 to 150 feet in width from the mouth of the river to Red Bank, on the North Branch, 8 miles, and to Branchport, on the South Branch, 9 miles.

In its original condition the river was much obstructed by sand bars, on which the best depths at mean low water were, at the mouth, 3.9 feet; below Highlands Bridge, 5.4 feet at Lower Rocky Point, 3.6 feet; at Barley Point, 3.3 feet; at Chalmer's, 5 feet; at Oceanic, 5.5 feet; below Bellevue, 3.1 feet; at Sea Bright, 4.2 feet; at Jumping Point, 2.6 feet; at Sedge Island, 2.8 feet. A survey, completed in April, 1887, shows the depth at these points to be 5.9 feet, 7.7 feet, 3.6 feet, 7.8 feet, 7.2 feet, 4.5 feet, 5.9 feet, 4.4 feet, respectively. The changes which have taken place in these depths during the past few years are not material, and are due to the constantly shifting sand of the estuary bed. The fine sand composing the bottom is so movable that it is quite impossible to foretell the position or extent of the new shoals which appear each spring, due to the winter's storms and tides; but during the summer the channels can be maintained in a fairly stable condition, because of the navigation by paddle steamers and the comparative absence of severe storms.

The three maps accompanying the present report will illustrate the unstable nature of the river bottom. The first shows its condition in the spring of 1889 before dredging, the second in the fall of 1889 after dredging the cross-over channel, and the third in the spring of 1891, the latter indicating the position of the temporary dike.

As stated in my report for 1890, a project for the expenditure of a portion of the $10,000 allotted by the act of September 19, in a temporary pile spur dike at Upper Rocky Point was submitted. This was approved October 20, 1890.

Specifications were prepared and sealed proposals invited by advertisement dated February 7, 1891, for building this temporary pile dike, by driving a row of piles 12 inches in diameter at the butt as close together as practicable, sawed off at a height of 1 foot above mean low water and connected together securely by an 8-inch by 12-inch waling piece, upon which were to be bolted 6-inch sheet piles placed in juxtaposition and penetrating 5 to 8 feet into the river bottom; the portion to be built consisting of 370 feet, and extending in the direction indicated on the diagram (number 3) accompanying the present report. Bids were opened March 20, the lowest responsible bidder being George Humphreys, at $7.75 per linear foot of dike completed (abstract herewith). This bid was approved, and a contract entered into March 30 for the construction of about 370 linear feet of dike.

Work was begun on April 30 and completed June 6, but before the completion of the dike it was found that the extensive scour would soon endanger it, and two loads of stone riprap have since been placed along the sides and around the clump of long piles forming its present terminal, thus increasing its cost to $3,728.51, which also includes a small item of $41.63, allowed as extras, found necessary during its construction.

Sufficient time has not yet elapsed to judge of the effects of this dike in controlling the ebb current, a portion of which it was hoped would be thereby deflected into the cross-over channel, but at the close of the year a survey for this purpose will be made. It is not expected, however, that the best results will be attained until the dike can be extended entirely across to the flats forming the middle ground.

The channels in the North Branch are now in as good condition as can be expected, but slight dredging being necessary at a point between Upper Rocky Point and Oceanic.

The act of September 19, 1890, appropriated $10,000 for the Shrewsbury River, stipulating that $5,000 should be expended upon the South Branch.

A project submitted for expending the $5,000 for the South Branch in dredging at the bend opposite Sea Bright and at such other points as might be suggested by the steamboat companies making use of the river, was approved October 20, 1890.

Specifications were prepared and sealed proposals invited by advertisement dated February 3, 1891, for improving Shrewsbury River, New Jersey (South Branch), by widening and deepening the channel at Normandie and Sea Bright, by dredging to a depth of 6 feet at mean low water where the depth is now from 4 to 6 feet. Bids were opened March 10, 1891, the lowest responsible bidder being P. Sanford Ross, at 35 cents per cubic yard, scow measurement (abstract herewith). This bid was approved and a contract entered into March 20, 1891, for the removal of 11,000 cubic yards, more or less, of material. Work was begun May 13 and was still in progress at the close of the fiscal year, when 11,045 cubic yards of material were removed. The material is being deposited behind the dike immediately south of the channel.

The dike at the mouth of the river, controlling the channel over the bar, is said by the navigators of the river to be one of the most useful and successful of the Government improvements. This dike is now in very bad condition, but measures will shortly be taken for its restoration.

For more detailed information concerning the history of the dikes reference is made to the Annual Report on this improvement for 1889. These dikes are in fair condition and have proved quite beneficial in maintaining the channel of the lower North Branch or Navesink.

It is thought that an appropriation of $15,000 could be utilized in dredging and restoring the dikes, which are in many places greatly in need of repair, and an additional amount of $8,000 is recommended in order to strengthen the shore line of Sandy Hook at a point between Life-Saving Stations 2 and 3, where the Hook becomes very narrow and liable to be washed out and breached by heavy storms, thus filling up the Shrewsbury River with sand. This portion has heretofore been kept in repair by the New Jersey Central Railroad Company, but after their abandonment of the route, by War Department order, on October next the narrow portion mentioned must be cared for by the Government.

In addition to the steamers which regularly use the river a large number of small sailing vessels are engaged in the shipment of coal, sand, fish, and oysters.

The estimated cost of the existing project is $254,562, of which $214,292.88 had been expended June 30, 1890.

The expenditures during the past fiscal year amounted to $4,205.22, as follows:

Cost of sheet-pile dike (North Branch)	$2,928.51
Cost of surveying	260.51
Cost of drafting	225.00
Cost of inspection	425.95
Cost of administration	365.25
Total	4,205.22

e amount necessary to complete the existing project is $30,062.

river is in the collection district of Perth Amboy, which is the nearest port of ; nearest light-house, Navesink Light; nearest fort, fort at Sandy Hook, New y.

ount of revenue collected at the port of Perth Amboy during the fiscal year endne 30, 1891, is $16,592.09.

al estimate (revised 1887)	$254,562.00
nt appropriated	224,500.00
nt expended	218,498.10

Money statement.

1, 1890, balance unexpended		$207.12
nt appropriated by act approved September 19, 1890		10,000.00
		10,207.12
30, 1891, amount expended during fiscal year		4,205.22
1, 1891, balance unexpended		6,001.90
1, 1891, outstanding liabilities	$800.00	
1, 1891, amount covered by uncompleted contracts	3,986.50	
		4,786.50
1, 1891, balance available		1,215.40
mount (estimated) required for completion of existing project		30,062.00
mount that can be profitably expended in fiscal year ending June 30, 1893		23,000.00
bmitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

ract of bids for improving Shrewsbury River, New Jersey, South Branch, by dredging, received and opened March 10, 1891, under advertisement dated February 3, 1891.

Name and address of bidder.	Price bid per cubic yard, measured in scows.		Amount available for dredging.	Amount of material that can be removed for price bid per cubic yard.
	At Normandie.	At Seabright.		
	Cents.	*Cents.*		*Cubic yards.*
nus D. Wright. Pleasure Bay, N. J	40	30	$4,000	10,683
rd Parrott, Newburg, N. Y	65	65	4,000	6,154
h Brainard, New York, N. Y	40	40	4,000	10,000
nford Ross, Jersey City, N. J.*	35	35	4,000	11,428

ntract entered into March 20, 1891, for the removal of 11,000 cubic yards, more or less, of material.

ract of bids for constructing timber dike in the North Branch, Shrewsbury River, r Jersey, received and opened March 20, 1891, under advertisement dated February 1891.

Name of bidder.	Address of bidder.	Rate per linear foot (370 foot).	Amount of bid.	Remarks.
y M. Doremus	Newark, N. J	$9.70	$3,589.00	
iam Parrott	Newburg, N. Y	8.25	3,052.50	
nford Ross	Jersey City, N. J	8.90	3,293.00	
ge Humphreys	Brooklyn, N. Y	7.75	2,867.50	Lowest bid.
A. Kelly	do	8.47	3,133.90	
lo Danforth	New York, N. Y	8.25	3,052.50	

mount available for diking, $3,000.

ntract entered into March 30, 1891, with George Humphreys, the lowest bidder, constructing about 370 feet of sheet-pile dike.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Shrewsbury River, New J sey, during the year ending December 31, 1890, were kindly furnished by Ca James S. Throckmorton, of Red Bank, N. J.:

Articles.	Amount.	Value.	Vessels.	No.	Average draft.	Avera tonna
	Tons.				*Feet.*	
Fertilizers	60,000	$420,000	Steam	20	4.5	
Coal	75,000	300,000	Sail	44	3	
Oysters and fish	6,500	650,000	Barges	18	3	
Produce	155,000	1,600,000	Rafts	20	....	......
Miscellaneous	260,000	2,215,000	....	....	....	......
Total	556,500	5,185,000	....	102	....	......

The above table shows an increase in the commerce of 30,500 tons over that ported for the year ending December 31, 1889.

F 15.

IMPROVEMENT OF MANASQUAN (SQUAN) RIVER, NEW JERSEY.

In its original condition this stream had a depth of from 4 to 6 fe at mean low water for several miles above its mouth, and was obstruct at its outlet into the ocean by a sand spit, which had deflected t stream into a channel parallel with the beach, communicating with t ocean across shifting sand-bars, on which the best depth did not exce 1½ feet at mean low water; mean range of tide 2.4 feet. In severe stor this channel was sometimes entirely closed by the sand.

The project for its improvement was adopted in 1879, and conte plated dredging the lower river and obtaining by means of jettie permanent outlet nearly at right angles to the beach, with a depth 6 feet at mean low water, at an estimated cost of $52,120.

The amount expended under this project to June 30, 1887, was $39,0 with which two jetties had been constructed, but neither to its f length, appropriations having ceased in 1882. No permanent impro ment had been effected.

In reference to the appropriation made in the recent river and har act attention is invited to the subjoined report, which was approved the Secretary of War, December 30, 1890.

NEW YORK, *December 19, 189*

GENERAL: The river and harbor act of September 19, 1890, includes the follow item: "Improving Squan River, New Jersey, by the removal of obstructions pla by the Government at the mouth of said river, if, in the discretion of the Secret of War, the same should be done, two thousand dollars."

In reference to this item I have the honor to submit the following special repo

Squan River, also known as Manasquan, is one of the numerous shallow inlets the New Jersey coast, which quite evidently, at one time were open to the sea, subsequently closed by continuous beaches, through which the inclosed water t forced a narrow passage. An instance of this in very modern times is shown Point Judith Pond, on the coast of Rhode Island.

In the New Jersey inlets there is a marked tendency, undoubtedly due to litt currents, to a northward extension of the south side of the outlet, which, in case of Sandy Hook, has reached a remarkable development. This developm of the south spit usually continues until the entrance forms a strong sigmoid cur and remains in this condition until the southern salient of the current thins out a weakens the adjoining portion of the sand spit to such an extent as to cause a rupt at this point, during some unusual storm, and the entrance henceforth takes this new direction, the old entrance filling up. The northward extension of the southern spit then gradually progresses as before, and so on indefinitely.

In the case of Manasquan, the regularity of this movement has been interfered with somewhat by the north dike, but the south dike has been of no benefit, for the reason that it was never united with the southern spit at its seaward extremity, thus allowing the current to run behind it and completely isolate it, as shown in the accompanying diagram, No. 4.

At present a portion of the eastern end of this dike extends, in a dilapidated condition, under the existing channel, which, however, shows depths at this point at least as great as those of the bar at the entrance.

In view of the facts that the channel is only used by a few pleasure yachts during the summer months; that the entrance is at any time liable to abandon its present course, as above explained, and that the limited amount of the appropriation would not afford sufficient inducement to contractors to undertake what must be a somewhat difficult and hazardous work, I am of the opinion that the removal of the obstructions alluded to in the act of September 19 is not necessary.

In regard to the history and past and present condition of this improvement, reference is made to the following report of Mr. C. S. Kelsey, assistant engineer:

REPORT OF MR. C. S. KELSEY.

NEW YORK, *October 17, 1890.*

CAPTAIN: I have the honor to submit the following information relating to the Manasquan Inlet improvement, and the condition of the Government works at that place:

Congress, in 1879, appropriated $12,000 for the improvement of the inlet, after a survey and plans had been submitted by Colonel Macomb, estimating the cost of the proposed improvement at $52,120.

Before work was begun the matter was submitted to the Board of Engineers and they reported, in 1880, against the advisability of undertaking any improvement, concluding that "the piers as proposed would not keep open a channel," and that they were not satisfied that the improvement of the harbor, as laid down in the plans, would be of much benefit. They estimated the cost of plans promising any hope of success to be from $200,000 to $260,000.

Congress, however, appropriated $20,000 more for the work, making a total of $32,000 available in 1881. Colonel Michler, then in charge, was instructed by the Chief of Engineers to expend this money according to plans suggested by Colonel Michler.

These plans were to the effect that, if it was decided to attempt some plan of improvement, the general lines of dikes as proposed by Colonel Macomb (see sketch 1) might be successfully adopted. But it was not expected to secure an available harbor of refuge, and the object of the works was simply to "restrain the wanderings of the inlet and to direct the flow of the tidal currents through the inlet in a constant channel across the beach;" while even this result was hardly to be hoped for without a further extension of the piers than the funds available would permit, and no reliable estimate of the final cost could be predicted.

In 1882 Congress appropriated $7,000 for continuing the work. A project changing the location of the south pier was approved, and work was begun on the south dike at a point in the proposed structure about 100 feet inside the end of the north dike as built. After building 475 feet of the dike inward toward the shore and reaching the low-water mark the funds were expended, leaving 300 feet yet to be built to connect with high-water mark at the shore. At the close of the work there was a good 4-foot channel into and through the dikes as shown by sketch 2.

The resultant effect of the two dikes as constructed soon developed the weak points in their location. The channel in the bay above being on the south side, while the opening between the dikes was on the north side, a reversed curve must be made to pass from one into the other. It was on these curves that the current needed assistance, giving the north dike a slight curve to the south to turn the flood in that direction, and also curving the inner arm of the south dike to the west to ease the abruptness of the ebb deflection toward the opening between the dikes. Under these conditions the flood would have to deposit its load of sand where the returning ebb could carry it out again.

As it was, the flood coming in heavily charged with sand was trained in a northwest direction by the north dike and directed square against a wide shoal on the north shore, just above the opening between the dikes, while the ebb coming down in a southeast direction expended its force on the south shore, and had no opportunity to attack the deposit of sand left on the shoal mentioned above.

Under these conditions the shoal enlarged rapidly, crowding the ebb more and more to the south as it widened out. Moreover the ebb, coming down, struck t inner arm of the south dike at nearly a right angle, and must either turn, cross ov and turn another right angle, or else cut for itself a new channel to the south a around the unfinished end of the south dike.

Following the course of least resistance the latter was what occurred. When t began to be apparent in the following year, 1884, an appeal was made to Congr for funds to complete the shore end of the dike. This appeal was continued e year without avail until 1888, when the work was stricken off from the lists of i provements.

Sketch 3 shows the condition in 1887, when a narrow cut had worked throu around the entire south dike.

Sketch 4 shows the present condition.

It has filled up solid between the dikes to a height of 4 or 5 feet above high wat no force being left to keep clear the opening when once the ebb had formed a pass south of the south dike.

Once clear of the dikes the channel was free to shift about under its original c ditions, and has now reached a stage precisely like that before the commencemen the work in sketch 1. Driven back by the wall of sand at the beach the curren turned against the outer end of the dikes and has demolished the last 100 feet of south dike, the thread of the current passing directly over the ruins. This forms obstruction having about the same depth over it as on the outer bar, 1¼ to 2 feet mean low water, or 4 to 4½ feet at mean high water. Were the whole south dike moved the channel might some day in its wanderings come back unaided to neighborhood of the north dike, but the probable outcome is that the mouth w become stopped up during a storm, and at its abatement a breach will occur giv a more direct outlet, the dikes becoming buried up entirely.

To remove the outer end of the south dike would render any attempt to pass inlet less hazardous, but it is not likely that any contractor would be tempted the funds available to risk his plant in so dangerous a locality. Moreover the ex ence and character of the outer bar limits its use to a few yachts in summer and gether with the railroad facilities presents the growth of any commerce.

It would not seem best therefore to attempt to remove any portion of the dik but it is suggested that $300 or more of the funds be made available for a sur showing more in detail the present condition and for further study of the chan that may take place in the inlet. Such a record would be of commensurate valu the profession.

Very respectfully submitted.

C. S. KELSEY,
Assistant Enginee

Capt. THOS. L. CASEY,
Corps of Engineers, U. S. A.

Respectfully submitted.

THOS. L. CASEY,
Captain, Corps of Engineer

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Division Engineer, Northeast Division.)

There were no expenditures on account of this work during the fis year.

This work is in the collection district of Perth Amboy, N. J., which is the nea port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nea fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy, N. J., during the fi year ending June 30, 1891, $16,592.09.

Original estimate (1879)	$52,
Revised estimate (1882)	72,
Amount appropriated	41,
Amount expended	39,

Money statement.

Amount appropriated by act approved September 19, 1890	$2, 00
July 1, 1891, balance unexpended	2, 00
Amount (estimated) required for completion of existing project	31, 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

F 16.

REMOVING SUNKEN VESSELS OF CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

WRECK OF BARGE NELLIE AT ENTRANCE TO ARTHUR KILL, NEW YORK AND NEW JERSEY.

NEW YORK, *September 22, 1890.*

GENERAL: I have the honor to submit the following report on the removal of the wreck of the barge *Nellie* at the entrance of Arthur Kill, near Elizabethport, N. J.

This wreck was reported as an obstruction by Mr. D. C. Chase in a letter dated July 23, 1890, the letter being transmitted to the Department on July 24. In reply a report was requested as to whether the wreck was such an obstruction to navigation as contemplated by section 4, river and harbor act of June 14, 1880, and, if so, requesting an estimate of cost of removal. A report with estimated cost of removal was submitted July 30, 1890, which was approved by the Secretary of War August 2, and the owners were thereupon notified August 6 that unless the wreck were removed by them within 30 days it would be removed by the United States as soon thereafter as possible.

Circular letters dated August 11 were sent to several of the most reliable dredging and wrecking firms in New York inviting bids for doing the work of removal, which bids were opened September 6. The firms bidding were as follows:

John F. Baxter, 308 West street, New York City, N. Y	$200
R. G. Packard, 33 Pine street, New York City, N. Y	240
William E. Chapman, 70 South street, New York City, N. Y	250

The bid of J. F. Baxter was accepted, and the bidder notified to begin work within the stipulated time of 10 days.

The wreck has been removed in a satisfactory manner. * * *

Respectfully submitted.

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

F 17.

PRELIMINARY EXAMINATION OF PRINCESS BAY, STATEN ISLAND, NEW YORK, FOR BREAKWATER.

[Printed in House Ex. Doc. No. 109, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 19, 1890.

SIR: I have the honor to submit herewith a copy of report, dated December 4, 1890, from Capt. Thomas L. Casey, Corps of Engineers, giving results of preliminary examination of "Princess Bay, Staten Island, for breakwater," New York, made to comply with provisions of the river and harbor act of September 19, 1890.

It is the opinion of Captain Casey and of Col. H. L. Abbot, Corps Engineers, Division Engineer, Northeast Division, that this bay is n worthy of improvement. I concur in their views.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE.
New York, December 4, 1890.

GENERAL: In compliance with department letter of September 2 1890, I have the honor to submit the following report on a prelimina examination of Princess Bay, Staten Island, New York, with a view its protection by dikes or other means.

Princess Bay is a shallow indentation or bight of the coast of Stat Island, and is exposed to storms from the east to southeast. It is sha low, but serves as a haven for very small boats, which at high tide ru into the mouth of a creek which opens into the bay to the westward Seguine Point.

There are two methods of protection which might be suggested; o a system of heavy dikes just outside the deep channel of Raritan Ba which may, however, be dismissed at once, as its cost will be at lea $300,000; the other by means of a smaller dike parallel with the sho line and extending southwestwardly from Seguine Point, as shown the accompanying sketch,* and the excavation of an inner harbor 8 by 300 by 8 feet at mean low water. This plan will cost $40,000.

The object of the proposed harbor is to protect the fleet of sma boats engaged in the oyster and clam industry, which, from the inclos document from the Census Bureau, seems to be very extensive. As protection to this amount of invested capital it would certainly appe desirable to have a small harbor at this point as a shelter from hea and sudden storms, but whether the protection of a single industr probably controlled by a few individuals, properly comes under t head of improvements for the benefit of commerce or is a fit subject f appropriations in the river and harbor bill is a doubtful point, whi I will not attempt to decide. In my opinion it does not come under th head, but is a proper subject for special legislation.

If, under these circumstances, it be deemed proper to make the su gested improvement, the survey will cost $500.

Respectfully submitted.

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Enginee Northeast Division.)

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*Not reprinted.

[Second indorsement.]

U. S. ENGINEER OFFICE,
New York, December 8, 1890.

Respectfully returned to Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.

* * * * * * *

This work is not worthy of improvement.

THOS. L. CASEY,
Captain, Corps of Engineers.

[Third indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, December 17, 1890.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

In my judgment this work is not worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

LETTER OF HON. ROBERT P. PORTER, SUPERINTENDENT OF CENSUS.

DEPARTMENT OF THE INTERIOR, CENSUS OFFICE,
Washington, November 14, 1890.

DEAR SIR: In response to your request made upon this office, I take pleasure in inclosing to you a preliminary statement of the number of vessels and men employed in oyster culture on the north side of Raritan Bay.

Very respectfully,

ROBERT P. PORTER,
Superintendent of Census.

Capt. THOS. L. CASEY,
United States Engineers.

DEPARTMENT OF THE INTERIOR, CENSUS OFFICE,
Washington, November 14, 1890.

DEAR SIR: In accordance with his request I have prepared for Capt. Thos. L. Casey, U. S. Army, a preliminary statement of the oyster and clam industry of Richmond County, N. Y. It is quite complete, but subject to such slight correction as may hereafter need to be made. It is not easy to separate that part of Richmond County which relates to Princess Bay. I believe, however, that the entire clam and oyster industry of that region would be more or less affected by any improvements which were made at Princess Bay.

Very respectfully,

C. W. SMILEY,
Special Agent Fish and Fisheries.

Hon. ROBERT P. PORTER,
Superintendent of Census.

Oyster and clam industry, Richmond County, New York.

CLAMS.

	Number.	Value.	Outfit.
Sloops	9	$6,350	$910
Other boats	71	4,027	998
Cash capital		500	
Total		10,877	1,908

Total capital invested	$12,785.00
Catch in 1889 (44,912 bushels)	36,442.70
Number of men employed	88

OYSTERS.

	Number.	Value.	Outfit.
Sloops	78	$80,050	$10,220
Other boats	318	20,276	4,062
Total	396	100,326	14,282

Total capital invested, boats	$114,608.00
Capital in other property	319,619.36
	434,227.36
Catch in 1889 (192,850 bushels)	192,850.00
Seed (60,331 bushels)	30,165.50
	223,015.50
Acres under cultivation	2,109.10
Number of men employed	490

F 18.

PRELIMINARY EXAMINATION OF HACKENSACK RIVER, NEW JERSEY, FROM BELOW THE NEWARK AND NEW YORK RAILROAD BRIDGE, ON NEWARK BAY, TO THE TOWN OF HACKENSACK.

UNITED STATES ENGINEER OFFICE,
New York, December 5, 1890.

GENERAL: I have the honor to make the following report on a preliminary examination of the Hackensack River, New Jersey, from Newark Bay to the town of Hackensack, in accordance with requirements of Department letter of September 20, 1890.

A preliminary examination, and later a survey, of the upper half of this part of the river was made in 1888–'89, and reports submitted to the Chief of Engineers on October 24, 1888, and June 30, 1889. The present examination was confined, therefore, to the lower 7 miles of the Hackensack River. An inspection of this length only was therefore made, and soundings taken above and below each of the ten bridge crossings to determine the relative position of draw to channel, and numerous soundings were made upon the bar or middle-ground, below the lower bridge. At each wharf inquiries were made concerning the amount of commerce and facilities required.

The Hackensack is a tidal river, flowing through low marshy land, with a mean rise and fall of 4.5 feet. Navigation on the river is limited to such craft as can cross Newark Bay, the outlet, where a depth of 10 feet mean low water has been made, and is to be maintained. The Hackensack possesses depths superior to those of the bay, and also an ample width for more than 12 miles above the bay, the only obstructions to free navigation being the numerous bridges.

The improvement asked for is a channel 10 feet deep at mean low water, through the shoal just below the lower bridge—the Central Railroad of New Jersey.

This shoal proves, on examination, not to be a bar across the channel, but a middle ground dividing the channel below the bridge into two branches; through the west branch the flood maintains a good channel 600 feet wide, from Newark Bay upward; the eastern branch, an ebb channel, shoals gradually from the bridge downward, disappears altogether at the entrance to the bay, and is useless for practical navigation. The bridge crosses the river just at the head of this shoal, where the channel divides, and the draw being located to the east instead of west of the shoal, compels vessels to cross this middle-ground, in going from the channel below through the draw to the channel above. The least depth where they cross the shoal is about 7 feet mean low water. Old surveys on the files, made before the building of the bridge, indicate that the same conditions existed then, and show that the locators of the draw were somewhat careless in fixing its position. By moving the draw about 400 feet to the westward it would be near the center of a continuous channel more than 600 feet wide, and all cause for complaint would be removed. The draw in itself is satisfactory, having two openings 50 feet in the clear and working by steam. To dredge off the head of the shoal would require a cutting 800 by 200 feet and the removal of 24,000 cubic yards, at a cost of $7,000. It is doubtful if such a cut would remain open if made, lying obliquely to the currents.

Two miles above this bridge there is another, the Hudson County Turnpike, seriously obstructing navigation. It lies just above two railroad bridges, the three being included within a distance of 600 feet. It has only one opening of 37 feet clear, and is placed close against the abrupt west bank of the channel. In addition to the narrowness of the draw, the flood current is said to run foul of the opening.

The remaining bridges, in comparison with these two, offer no serious obstruction to present commerce.

The water front along the east bank of the Hackensack, being situated just back of Jersey City, which is rapidly extending to the banks and certain to require and utilize all available water front, is already held at high valuations and entitled to the protection and maintenance of the full capacity of the Hackensack Channel. At present there are but eight docks below the Erie Railroad Bridge, doing an annual business estimated as follows:

Articles.	Tons.	Value.
Lumber	1,600	$750,000
Brick and building material	8,000	25,000
Sand and miscellaneous	2,000	3,600
Total	11,600	778,600

To this must be added the commerce above the Erie Bridge, estimated in the report of 1889 at 246,540 tons—value, $1,743,345.

This river is worthy of improvement, and a survey at the localities of the two obstructing bridges, on which to base a relocation of the draw openings or dredging below the lower bridge, is estimated to cost $400.

Respectfully submitted.

THOS. L. CASEY.
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[Third indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, December 16, 1890.

Respectfully forwarded to the Chief of Engineers.

I concur with Captain Casey in thinking that this river is worthy of improvement, and favor the survey recommended.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

SURVEY OF HACKENSACK RIVER, FROM BELOW THE NEWARK AND NEW YORK RAILROAD BRIDGE, ON NEWARK BAY, TO THE TOWN OF HACKENSACK.

UNITED STATES ENGINEER OFFICE,
New York, September 5, 1891.

GENERAL: I have the honor to transmit herewith a report on the survey of the Hackensack River, New Jersey, "from below the Newark and New York Railroad Bridge, on Newark Bay, to the town of Hackensack," as authorized by the act of Congress approved September 19, 1890.

The act of August 11, 1888, authorized the survey of that portion of the river between the lower bridge in the town of Hackensack and the Erie Railway Bridge, and a report and accompanying map, upon this portion of the river, was published in my Annual Report for 1889, page 842 *et seq.* In order to complete the survey, as ordered by the act of September 19, 1890, it only remained, therefore, to investigate that portion of the river between the Erie Railway Bridge and a point "below the Newark and New York Railroad Bridge, on Newark Bay."

The accompanying report of Mr. C. S. Kelsey, assistant engineer, who made the survey, May 9–25, 1891, will give the details of the work and explain the methods pursued in taking the thorough system of current measurements in the neighborhood of the bridges, which form one of the most conspicuous and useful features of the survey.

The channels throughout this part of the river are uniformly wide and deep, and the principal obstructions are the numerous bridges and a shoal which partially obstructs the entrance into the shallower water of Newark Bay, and which divides the broad channel above into two channels, corresponding to the ebb and flood currents.

The better and probably more permanent of these channels, and, therefore, the one which the permanent improvement of the stream would prompt us to adopt, appears to be the west or flood channel, but as the draw in the present bridge is now in the ebb channel this would involve the shifting of the present draw, and is scarcely necessary at present, as, by making use of the cross channel, shown on the map,* below the bridge, the ebb channel can be utilized. These facts can be clearly seen from the larger of the two maps,* transmitted herewith.

The widening of this cross-over channel to a width of 200 feet, with a depth of 10 feet at mean low water, would involve an expenditure of $2,500, and it is recommended that this channel be properly buoyed by the Light-House Board, so that it can be made use of in lieu of dredging a channel over the shoal in the present course of vessels, which would cost $6,000.

In comparison with the upper reaches of the river, as described in my previous report, the lower river is, however, not in need of improvement at present, and it is recommended that any money which may be appropriated, be expended on that portion of the river between the lower bridge in the town of Hackensack and the Erie Railway Bridge, the required funds for which I have previously estimated to be $60,000.

The nearest port of entry is Newark, N. J. The amount of revenue collected at Newark during the fiscal year ending June 30, 1891, was $4,118.94.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. C. S. KELSEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, August 22, 1891.

CAPTAIN: I have the honor to submit the following report, with map in two sheets, upon the survey of the Hackensack River, from Newark Bay to the town of Hackensack, made in compliance with the Department letter of December 17, 1890.

A general description of the river, its physical conditions, and its present and prospective commerce was given in your preliminary report to the Chief of Engineers, dated December 5, 1890. As stated in that report, additional information in detail for a comprehensive study of the river in its entirety was required in but two localities to supplement your survey and report upon the section above the Erie Railroad bridge, made and submitted on June 30, 1889.

The surveys were made during May 9 to May 25, 1891. The first section extends from Newark Bay to the Newark Plank Road Bridge, a distance of 1¼ miles.

From above the Plank Road Bridge up to the Erie Railroad Bridge, where the previous survey of 1889 begins, the channel is broad and deep, the only obstructions to navigation being the drawbridges.

A survey of the worst of these obstructing bridges comprises the second sheet of this survey. The lower section was made a continuation of the Newark Bay survey of 1887; so that no base-line work was required, and the soundings refer to the same plane of mean low water determined by the United States Engineers in 1879.

The current observations, taken at various stages of both flood and ebb tide, were made with floats submerged to a depth of 6 feet, eliminating almost entirely the surface forces.

The utility of the deep, wide channels of the Hackensack is restricted by the shoal waters of Newark Bay into which it flows. The depth maintained through the bay channel is 10 feet at mean low water. An inspection of the map shows a channel in the Hackensack above the bridge of the Central Railroad of New Jersey over 10 feet deep at mean low water throughout a width of over 700 feet.

Below the bridge an extensive shoal exists, separating the waters into a flood and ebb channel.

The draw of the railroad bridge is located over the ebb channel, being to the east of the shoal which extends close up to the bridge. This ebb channel was supposed to shoal up and disappear on the flats at the mouth so that all vessels passing the draw are accustomed to cross over the head of the shoal below and in front of the draw, and pass into the west or flood channel. The minimum depth on this shoal is 7.1 feet mean low water, and is directly in the present course of the traffic.

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*Not printed.

It was this obstruction to the free navigation of the channels above and below which occasioned the call for a further survey of the Hackensack and a project for improvement.

The survey develops the fact that the ebb channel is not altogether lost below the bridge, but cuts across the shoal and joins the west channel 2,500 feet below the bridge.

There is not quite 10 feet at mean low water on this cross over, but 9.5 and over for a width of 200 feet or 2½ feet better than over the course now used by vessels, with easier turns and at a greater distance from the draw. An old map on file, supposed to be a copy of one made by the U. S. Coast Survey in 1836 and before the bridge was built, indicates that this shoal was then in existence and in about the same shape as now and there was a depth of 10 feet in the cross-over channel below the shoal.

Judging from the set of the currents, as shown on the map, and the character and condition of the channels, a permanent improvement looking towards the probable increase in the capacity of the Newark Bay Channel and providing for the future needs of the Hackensack as well as present relief would be best obtained by adopting the west or flood channel; and would include the relocation of the draw in the Central Railroad of New Jersey Bridge, moving it 450 feet to the west; which, with the removal of a slight shoaling on the west side of the channel on the line of the bridge, about 12,000 cubic yards would make available the full capacity of the channels above and below.

The removal of the draw would hardly seem required by the present conditions, since if this cross-over channel be properly buoyed any vessel that can now cross the bay should be able to pass up through the draw. The survey of 1836 would indicate, too, that this channel is permanent. Should these conditions change, however, no dredging would seem desirable until the draw be relocated, so that the improvement can be applied to the west channel, since cross-over channels are rarely permanent, and difficult to navigate because of the cross-currents.

Should dredging be employed, with the draw in its present position, it would require, to improve the cross-over to a channel 10 feet deep at mean low water and 200 feet wide, the removal of 6,000 cubic yards of material, at an estimated cost of $2,500; to dredge a channel 10 feet deep and 200 feet wide through the shoal along the course now used by vessels would require the removal of 15,000 cubic yards of material, at an estimated cost of $6,000.

The annual commerce of the river, as given in detail in your report of December 5, 1890, reaches a total of 258,140 tons, valued at $1,743,345.

From a consideration of the above facts, and those set forth in your report of June 30, 1889, on the Hackensack above the Erie Railroad bridge, the needs of the latter, as provided for in your project, estimated to cost $60,000 and benefiting 95 per cent. of the total tonnage, or 55 per cent. of the total valuation, would seem to be the most pressing, should any appropriation be made by Congress for the general improvement of the Hackensack River.

I would respectfully recommend that a blue-print of the survey be sent the Light-House Department, and they be requested to properly buoy the cross-over channel and inform navigators of its existence.

The second section of this survey calls for little comment.

A deep channel extends from bank to bank. Three bridges are located within a distance of 800 feet, and the draw in each bridge is located close against the west bank of the channel. The Turnpike Bridge, belonging to Hudson County, is the worst obstruction, having only one opening of 38 feet, and the currents setting foul of that, as indicated on the map, and with no opportunity between bridges to acquire steerageway and control of a vessel. The present traffic requires a draw with two openings of from 40 to 60 feet in the clear, properly located with reference to the lower bridge draws. The need for any longer continuing the existence of the intermediate or Pennsylvania Railroad freight bridge is questioned, as one good bridge would answer the purpose of the two old ones. They both serve the same line.

Very respectfully submitted.

C. S. KELSEY,
Assistant Engineer.

To Capt. THOS. L. CASEY,
Corps of Engineers, U. S. A.

APPENDIX G.

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY, SCHUYLKILL RIVER, PENNSYLVANIA, AND RIVERS IN SOUTHERN NEW JERSEY; HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY; CONSTRUCTION OF PIER AT LEWES, DELAWARE; DELAWARE BREAKWATER, DELAWARE.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1 Delaware River, Pennsylvania and New Jersey.
2. Harbor between Philadelphia, Pennsylvania, and Camden, New Jersey.
3. Schulykill River, Pennsylvania.
4. Ice-harbor at Marcus Hook, Pennsylvania.
5. Ice-harbor at head of Delaware Bay, Delaware.
6. Construction of iron pier in Delaware Bay, near Lewes, Delaware.
7. Harbor at Delaware Breakwater, Delaware.
8. Rancocas River, New Jersey.
9. Alloway Creek, New Jersey.
10. Maurice River, New Jersey.
11. Removal of wrecks from Delaware Bay and River.
12. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

13. Shark River, New Jersey.
14. Sound between Barnegat Bay and Great Egg Harbor Bay, New Jersey.
15. Little Egg Harbor Bay and Inlet, including Great Bay, New Jersey, with reference to establishing a harbor of refuge.
16. Thoroughfare from Cape May to the Great Bay north of Atlantic City, New Jersey.
17. Cape May City, New Jersey, for breakwater.
18. Pensauken Creek, New Jersey.
19. The West Branch of the Susquehanna River in the State of Pennsylvania.
20. Toms River, New Jersey.
21. Goshen Creek, New Jersey.
22. Delaware Bay, with a view of determining the best site near the mouth of the same for a national harbor of refuge suitable for deep-draft vessels.

HARBOR LINES.

23. Establishment of harbor lines in the port of Philadelphia.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., July 9, 1891.

GENERAL: I have the honor to transmit herewith the annual reports for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1891.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

G 1.

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY.

At the beginning of the fiscal year a balance of $60,054.92, exclusive of outstanding liabilities but inclusive of the amount covered by existing contracts, was available from the appropriation of August 11, 1888. The river and harbor act of September 19, 1890, contained an appropriation of $250,000 for improving Delaware River from Trenton to its mouth, $10,000 of which was to be expended on the Rancocas River, one of the tidal tributaries of the Delaware. The improvement of the Rancocas River is made the subject of a special report.

The expenditures during the past fiscal year have been applied for the furtherance of the approved project based upon the recommendations of the Board of Engineers of 1884, for the permanent improvement of the Delaware River by the formation of a channel 600 feet wide and 26 feet deep at mean low water from Philadelphia to the sea, and for the improvement of the Delaware River between Trenton and Bridesburg, in accordance with the project approved February 28, 1890, for the formation of a channel 12 feet deep at mean low water over Kinkora Bar.

The expenditures have been applied to the following operations:

1. Examinations at Kinkora Bar, Five-Mile Bar, and Mifflin Bar, to determine the action of works already built upon the channels at these localities.
2. Improvement of Kinkora Bar.
3. Improvement of Bulkhead Bar.

These operations will be described in the above order, except that examinations where works are in progress will be considered in connection with those improvements.

1. EXAMINATIONS OF THE RIVER AT VARIOUS LOCALITIES.

Five Mile Bar.—This obstruction lies directly above the upper end of Petty Island in the port of Philadelphia. The works existing for its improvement consist of a dike extending from the New Jersey shore at Fishers Point to within 2,000 feet of the head of Petty Island. At the close of the previous fiscal year the dike had reached an extension of 4,500 linear feet, of which the upper 3,500 linear feet consisted of a random stone dike founded upon a brush mattress sill, and backed with gravel and bowlders derived from the excavation of the channel at Port Richmond, and the lower 1,000 linear feet of a pile dike filled with stone. The tops of these constructions were carried to a height of 2 feet above mean high water. This dike has not been extended during the past fiscal year.

At the close of the fiscal year of 1890 the action of the dike had formed a channel across Five Mile Bar 11½ feet deep at mean low water and about 500 feet wide. The examination recently made shows that a channel from 12 to 13 feet deep and 150 feet wide now exists across the bar; that the flood tide channel north of the bar has materially moved upstream, and with this movement the 12 and 18 foot contours of the flood channel in the vicinity of the crossing have rolled from 150 to 200 feet to the southward; with this displacement of the bar there has been at the crossing a downstream movement of its lower end of about 300 feet. In general terms the changes which have occurred during the past fiscal year have been advantageous.

Although this dike was planned originally for the improvement of Five Mile Bar and its immediate vicinity, it has developed into an important factor in the subsequent plan for the improvement of the harbor of Philadelphia, whereby the ultimate closure of the New Jersey Channel between Fishers Point and the head of Petty Island is required. In the existing contract for the improvement of Philadelphia Harbor provision is made for depositing the stone backing, which is behind the revetments of the islands, and in the dikes north of Smith Island, in the gap between the lower end of the Fishers Point dike and the head of Petty Island. It is anticipated that the stone derived from these sources will materially reduce the cost of completing this dike without any increased expense to the United States.

Mifflin Bar.—This obstruction lies about 10 miles below Philadelphia. The existing works for its improvement consist of a random stone dike upon a brush mattress foundation extending from the Pennsylvania shore at Hog Island to the head of Maiden Island, a distance of 7,200 feet. The object of the dike is the improvement of the main ship-channel over Mifflin Bar by the concentration of the tidal currents. The dike was commenced in 1885 and completed to the height of mean low water in September, 1888; since that date no additions have been made to the work.

At the close of the fiscal year 1890 a channel across the bar, dredged in November, 1888, carried a mean low-water depth of 25 feet in a channel with a minimum width of 200 feet and a depth of 24 feet in a channel 275 feet wide. The examination recently made shows that the 25-foot channel has been reduced in width to 175 feet, but the 24-foot channel remains unchanged. While these changes have slightly reduced the width and depth over the upper end of the bar, the lower part of the channel has materially increased both in width and depth.

From the frequent examinations made at Mifflin Bar since the completion of the dike to the plane of mean low water in 1888 it is evident that to maintain a 26-foot low-water depth in a channel 600 feet wide across the bar the present dike between Hog and Maiden Islands will have to be materially raised in height. The cost of raising this dike to the plane of high water will be about $100,000, and should funds become available the work might with advantage be undertaken in 1892.

2. IMPROVEMENT OF KINKORA BAR.

This locality is situated in the reach of river between Trenton, N. J., and Bridesburg, Pa., and about 25 miles above the foot of Market street, Philadelphia. In its natural condition Kinkora Bar carried a ruling depth of 7½ feet at mean low water and formed the only obstruction to a 12-foot low-water channel as far up river as Whitehill or to within 5 miles of Trenton.

The project for the improvement of this locality, approved February 28, 1890, proposed the formation of a 12-foot low-water channel across the bar by the aid of a dike, partly closing the slough south of Newbold Island, supplemented by dredging on the line of the proposed channel. The funds available for this work were $15,000 derived from the appropriations of 1886–1888.

Under date of April 24, 1890, a contract was entered into with William T. Gaynor for the construction of 600 linear feet of pile and stone dike; and on July 17, 1890, an agreement was made with E. H. Gaynor for the construction of 200 linear feet of earthern embankment faced with stone. This latter work covered the gap which would otherwise have existed between low and high water lines.

This work, which was in progress at the close of the previous fiscal year, was completed on September 11, 1890.

Under date of August 21, 1890, a contract was entered into with Frank C. Somers for the dredging required in the formation of a channel 100 feet wide and 12 feet deep at mean low water. This work was accomplished September 6, 1890, by the removal of 15,454 cubic yards of sand and mud. Under an agreement with Frank C. Somers, dated September 5, 1890, a further quantity of 15,102 cubic yards were removed in widening the previously dredged channel to about 175 feet. Under this contract and agreement an aggregate of 30,556 cubic yards were removed at a cost of 7.9 cents per cubic yard.

From an examination made at the close of the fiscal yeari t is found that a channel with a depth of about 9½ feet at mean low water is carried across the bar. The action of the dike, extending from the lower end of Newbold Island and partly closing the slough south of the island, has resulted in reducing by about 300 feet the former distance between the 11-foot contours above and below the bar and has produced a valuable downstream extension of the lower end of the island. It may be anticipated that this favorable action of the dike will be progressive.

3. IMPROVEMENT OF BULKHEAD BAR.

This locality is situated about 36 miles below Philadelphia, or about 3 miles above Fort Delaware. In its unimproved condition the shoal carries from 20 to 21 feet at mean low water, and although the channel across the bar has been repeatedly deepened by dredging, it soon returns to its original condition, and forms the most marked obstruction to commerce in the navigation of the river between Philadelphia and the sea.

The project of the Board of Engineers of 1884 for the improvement of this locality proposed the construction of a random stone dike, about 14,000 feet in length, brought to the height of mean low water, and extending along the easterly side of Bulkhead Shoal from the upper end of Pea Patch Island, up stream, in a curved line approximately parallel to the New Jersey shore opposite.

For reasons given in the Annual Report of the Chief of Engineers for 1890, page 872, a project was submitted, and approved May 15, 1890, in which pile dikes filled with stone were substituted for the previously proposed random stone dikes, and east and west dikes in place of the single dike along the west side of the channel. Under this revised project the lengths of the east and west dikes are, respectively, 4,200 and 6,800 linear feet, and their estimated cost, $280,000.

Under date of July 26, 1890, a contract was made with Colin McLean for the construction of 2,600 linear feet of the east dike; and on March 5, 1891, a contract with Isaac H. Hathaway for the construction of the remaining 1,600 linear feet of the east dike.

During the fiscal year work was in progress under Colin McLean's contract on 2,400 linear feet of dike, of which 1,300 linear feet was practically completed. Under the contract with Isaac H. Hathaway work was in progress on 400 linear feet of dike, none of which was completed at the close of the year.

The number of deep-draft vessels navigating the Delaware River having much increased during the present season, the shoal areas at Bulkhead Bar were found to be a very annoying obstruction to commerce. As a measure of temporary relief, an agreement, under date of May 23, 1891, was made with the American Dredging Company to remove about 45,000 cubic yards of material, at 18 cents per cubic yard, in the formation of a channel across the bar about 200 feet wide and 24 feet deep at mean low water. At the close of the fiscal year 42,287 cubic yards had been removed.

It is not anticipated that the channel formed by this dredging will be permanent, but the urgency of giving even temporary relief to commerce was considered sufficient to justify the expenditure.

The dike in progress has not yet reached a sufficient extension to produce any valuable effect on the bar which it is designed to improve. With the close of the present season the east dike will probably be completed, and it is anticipated that the interval which will elapse before the commencement of the work next season will be sufficient to demonstrate its effect upon the bar, and also furnish the necessary data for the exact location of the companion dike on the west side of the shoal.

The partial improvement of the channels over Mifflin Bar, Schooner Ledge, and Cherry Island Flats has given a channel of navigable width and 24 feet deep at mean low water from Philadelphia to Bulkhead Bar, a distance of 36 miles, and this locality forms at present such a serious obstruction to navigation that the demands of commerce require its earliest possible improvement. For this reason it is considered desirable that available funds should be first applied to the completion of the works projected for the improvement of Bulkhead Bar, as provided for in my project submitted October 3, 1890, and approved October 15, 1890, for the application of the appropriation of September 19, 1890.

The Delaware River is tributary to the following collection districts: Trenton, Philadelphia, Wilmington, and Bridgeton. The amount of revenue collected in these districts during the year ending December 31, 1890, was $27,582,420.68.

Total amount appropriated for improvement of Delaware River from 1836 to June 30, 1891	$2,252,000.00
Total expenditures to June 30, 1891	1,980,359.55
Total amount appropriated on present project to June 30, 1891	900,000.00
Total expenditures on present project to June 30, 1891	628,359.55

Money statement.

July 1, 1890, balance unexpended		$69,058.22
Amount appropriated by act approved September 19, 1890		240,000.00
		309,058.22
June 30, 1891, amount expended during fiscal year		37,417.77
July 1, 1891, balance unexpended		271,640.45
July 1, 1891, outstanding liabilities	$12,803.51	
July 1, 1891, amount covered by uncompleted contracts	72,563.82	
		85,367.33
July 1, 1891, balance available		186,273.12
Amount (estimated) required for completion of existing project		1,725,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for constructing a pile and stone dike in the Delaware River a Bulkhead Bar, opened July 17, 1890, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantities.						Amount.
		Delaware pine piles, 80,000 linear feet.	Georgia pine timber, 160,000 feet, B. M.	White oak timber, 68,000 feet, B. M.	Wrought iron tie-rods, screws, bolts, and washers, 46,000 pounds.	Drift-bolts and spikes, 10,000 pounds.	Stone filling, 17,000 cubic yards.	
		Per linear foot.	*Per 1,000 feet, B. M.*	*Per 1,000 feet, B. M.*	*Per pound.*	*Per pound.*	*Per cubic yard.*	
1	Ira Lunt, New Castle, Del	$0.18	$36.00	$39.00	$0.04	$0.03½	$1.38	$48,462.00
2	I. H. Hathaway & Co., Philadelphia, Pa	0.18	35.00	38.00	0.04	0.04	1.33	47,434.00
3	Colin McLean, New York, N. Y	0.11½	35.00	35.00	0.04½	0.03¼	1.31	41,845.00
4	Alvin R. Morrison Co., Wilmington, Del	0.13¾	34.00	38.50	0.03	0.03⅛	1.30	42,850.50
5	Davis & Irvin, Philadelphia, Pa	0.14	37.50	44.00	0.03	0.03	1.35	44,822.00
6	William T. Gaynor, Fayetteville, N. Y	0.15	37.00	39.00	0.03	0.03	1.35	45,202.00
7	George C. Platt, Philadelphia, Pa	0.13	34.00	40.00	0.03⅜	0.03⅜	1.37½	43,825.00
8	Joseph S. Allen, Philadelphia, Pa	0.13	35.00	37.00	0.03½	0.03	1.35	43,376.00

Contract (dated July 26, 1890) entered into with Colin McLean. In progress.

Abstract of proposals for dredging in Delaware River at Kinkora Bar, opened August 16, 1890, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed, 15,000 cubic yards.	Amount.
		Per cubic yard.	
1	Frank C. Somers, Camden, N. J	$0.07 9/10	$1,185
2	Michael Herron, Bordentown, N. J	.18	2,700
3	American Dredging Company, Philadelphia, Pa	.09	1,350

Contract (dated August 21, 1890) entered into with Frank C. Somers.

Abstract of proposals for constructing a pile and stone dike in the Delaware River at Bulkhead Bar, opened February 23, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantities.							Amount.
		White-oak timber, 65,000 linear feet.	Delaware pine piles, 4,000 linear feet.	Georgia or Florida pine timber, 87,000 feet, B. M.	White oak timber 34,000 feet, B. M.	Wrought-iron tie-rods, screw bolts, and washers, 34,000 pounds.	Wrought-iron drift bolts, 5,000 pounds.	Stone filling, 21,000 cubic yards.	
1	Davis & Irvin, Philadelphia, Pa.	*Per lin. ft.* $0.25	*Per lin. ft.* $0.13	*Per 1,000 ft. B.M.* $35.00	*Pr 1,000 ft. B.M.* $38.00	*Per lb.* $0.03	*Per lb.* $0.03	*Per cu. yd.* $1.32½	$50,102.00
2	Ira Lunt, New Castle, Del.	.24	.16	38.00	45.00	.04	.03	1.35	50,936.00
3	Delaware Construction Company, Wilmington, Del.	.26½	.16	35.50	43.00	.03½	.03½	1.27½	50,555.50
4	Joseph S. Allen, Philadelphia, Pa.	.30	.13	39.00	37.00	.03½	.03	1.29	53,101.00
5	Isaac H. Hathaway, Philadelphia, Pa.	.24	.14	35.00	36.00	.04	.04	1.33	49,919.00

Contract (dated March 5, 1891) entered into with Isaac H. Hathaway. In progress.

COMMERCIAL STATISTICS.

The following statements concerning the foreign commerce of the Delaware River for the year ending December 31, 1890, are compiled from the reports of the board of trade, the commercial exchange, and the maritime exchange of the city of Philadelphia:

Articles.	Gross tons.
IMPORTS.	
Drugs and chemicals	62,719
Groceries and provisions	8,261
Flour	3,939
Cement	27,600
Clay	7,493
Coal	2,549
Cotton and cotton fabrics	1,288
Hemp, jute, and flax	3,490
Wool and woolen fabrics	9,820
Glass	540
Fruits	26,600
Fertilizers	4,566
Chalk	15,150
Asphaltum	8,240
Rags	3,086
Plaster of paris	8,790
Salt	14,270
Tin	49,709
Iron ore	686,682
Iron, manufactured	21,016
Flax seed	6,750
Sugar and molasses	445,000
Tobacco	450
Nickle and copper ore	300
Pitch	2,260
Wines and liquors	990
Miscellaneous	2,604
Total	1,424,162
EXPORTS.	
Corn	428,283
Wheat	18,900
Flour	84,102
Cars and locomotives	7,360
Coal	299,413
Cotton	8,660
Glucose	1,957
Iron, crude and manufactured	770
Oil cake	25,500
Mineral oil and products	559,000
Other oils	200
Beef, pork, and products	35,470
Grass seeds	351
Groceries and provisions	2,770
Sugar and syrup	10,220
Tobacco	3,215
Lumber	15,300
Miscellaneous	1,300
Total	1,502,771

Value of imports	$56,057,011	
Value of exports	36,462,951	
		$92,519,962
Passengers arriving from foreign countries		25,322
Passengers departing for foreign countries		5,741
Total		31,063

Comparative statement of values of exports, imports, and revenue collected.

Year.	Exports.	Imports.	Revenue.
1886	$33, 607, 386	$37, 997, 005	$16, 303, 918
1887	33, 813, 024	39, 572, 398	17, 950, 235
1888	28, 012, 879	45, 020, 132	20, 567, 684
1889	31, 403, 720	50, 996, 802	22, 612, 956
1890	36, 462, 951	56, 057, 011	27, 572, 351

Foreign entrances and clearances.

Class.	Entered from foreign ports.				Cleared for foreign ports.			
	With cargoes.		In ballast.		With cargoes.		In ballast.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
American steam vessels	49	56, 110	2	133	29	44, 364	17	5, 974
American sail vessels	305	154, 364	2	3, 001	181	100, 578	2	1, 771
Foreign steam vessels	669	887, 438	92	144, 973	491	712, 417	92	59, 690
Foreign sail vessels	266	165, 124	44	44, 558	281	198, 319	12	5, 918
Total	1, 289	1, 263, 036	140	192, 665	982	1, 055, 678	123	73, 353

The following statements concerning the domestic and costwise commerce of the Delaware River, for the year ending December 31, 1890, have been compiled from returns made to this office by shippers and consigners:

Article.	Gross tons.	Article.	Gross tons.
ARRIVING.		Unclassified	2, 138, 258
Ice	603, 635	Total	3, 746, 877
Chemicals	11, 003		
Oysters and fish	103, 561	DEPARTING.	
Iron, manufactured	79, 056		
Coal	166, 846	Coal	3, 044, 130
Cotton	15, 050	Iron, manufactured	141, 230
Lumber	216, 234	Cotton	170
Railroad ties	87, 848	Lumber	31, 696
Wood	12, 633	Manure	60, 217
Stone, building	49, 085	Petroleum	27, 020
Stone, paving block	40, 064	Fertilizers	18, 009
Sand	178, 582	Unclassified	1, 363, 927
Fertilizers	42, 952		
Sugar	2, 070	Total	4, 686, 399

Passengers arriving at Philadelphia	949, 079
Passengers departing from Philadelphia	979, 476
Total	1, 928, 555

Domestic and coastwise arrivals and departures in cargo.

Class.	Arrivals.	Departures.
Steamers	*9, 678	9, 785
Sailing vessels	5, 420	4, 208
Canal-boats and barges	†17, 110	‡18, 358
Rafts	205	235
Total	32, 413	32, 586

* Excluding tugboats and ferryboats.
† Including 9,040 railroad lighters between Camden and Philadelphia.
‡ Including 6,718 railroad lighters between Philadelphia and Camden.

SUMMARY.

Freight movement.

	Gross tons.
Arriving, foreign	1,420,223
Departing, foreign	1,502,771
Arriving, domestic	3,746,877
Departing, domestic	4,686,399
Total	11,356,270

Vessel movement.

Steam vessels, foreign trade, arriving	812
Sailing vessels, foreign trade, arriving	617
Steam vessels, foreign trade, departing	629
Sailing vessels, foreign trade, departing	476
Steam vessels, domestic trade, arriving	9,678
Sailing vessels, domestic trade, arriving	5,420
Canal-boats and barges, domestic trade, arriving	17,110
Rafts, domestic trade, arriving	205
Steam vessels, domestic trade, departing	9,785
Sailing vessels, domestic trade, departing	4,208
Canal-boats and barges, domestic trade, departing	18,358
Rafts, domestic trade, departing	235
Total	67,533

Tonnage of Delaware River to and from Wilmington, Del., not included in the foregoing statement of freight movement, 852,924 gross tons.

G 2.

IMPROVEMENT OF HARBOR BETWEEN PHILADELPHIA, PENNSYLVANIA, AND CAMDEN, NEW JERSEY.

The adopted project for this improvement is contained in the report of a Board of Engineers, dated March 30, 1888, and published in the Annual Report of the Chief of Engineers for 1888. It provides for the removal of Windmill and Smith Islands and the adjacent shoals so as to form a 26-foot channel, about 1,000 feet wide, or wider if found practicable during the progress of the work, along the front of the revised Philadelphia wharf line, from Kaighn Point to the foot of Petty Island. It is further proposed to widen the Pennsylvania Channel at Petty Island so as to give it a width of about 2,000 feet, a depth of 26 feet over a width of about 1,000 feet more or less, the channel sloping to a depth of 12 feet in the remaining width, and a resulting cross-section at half tide of about 55,000 square feet. The cost of the dredging required to carry out this project was estimated at $3,500,000.

At the beginning of the fiscal year title to the lands necessary for the improvement had been vested in the United States, and the sum of $200,000, being part of the appropriation made in the river and harbor act of August 11, 1888, was available for the commencement of the work.

The act of March 2, 1889, making appropriations for the naval service for the fiscal year ending June 30, 1890, provided $75,000 for dredging and filling in at League Island, and authorized the Secretary of the Navy to coöperate with the Secretary of War in the expenditure of this sum in utilizing any material that may be removed from adjacent waters under appropriations made by Congress.

A project for the application of these sums was submitted on July 16, 1890, and modified and approved on July 28,1890. It provided for the application of the sum of $200,000 from the appropriation in the river and harbor act of August 11, 1888, to the removal of Smith and Windmill Islands to a depth of about 8 feet below mean low water, a part of the material excavated to be dumped at or near League Island, and for the application of the sum of $75,000, appropriated in the naval act of March 2, 1889, to the placing of material in the navy-yard, under the direction of the naval authorities. This project is appended hereto.

Proposals for the execution of this work were opened on September 16, 1890, and submitted to the Department on the same date.

The river and harbor act approved September 19, 1890, contained an appropriation of $200,000 for this improvement, with the following provisions:

> *Provided,* That contracts may be entered into by the Secretary of War for the work required for the improvement of the Delaware River between the cities of Philadelphia, Pennsylvania, and Camden, New Jersey, according to the plan reported by the Board of Engineers, and transmitted to Congress April seven, eighteen hundred and eighty-eight, and printed as House Executive Document two hundred and sixty, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided,* That the cost of the improvement shall not be thereby increased, to be paid for as appropriations may from time to time be made by law.

Under instructions of the Department, dated September 20, 1890, a project for the application of the funds thus appropriated was submitted on November 15, 1890. It provided for the continuation of the improvement by the removal of the dikes which revet the cut across the shoal north of Smith Island and the wharfing along the north part of Petty Island, and by the dredging of about 1,000,000 cubic yards of material from the north front of Petty Island, the cut to be outside of the existing earthen dike and extend to a depth not exceeding 8 feet at mean low water. This project is appended hereto.

Under instructions of the Department, dated September 22, 1890, all the bids opened on September 16, 1890, were rejected, and a draft of specifications was prepared for submission to a Board of Officers of the Corps of Engineers, to be convened for its consideration.

Under instructions of the Department, dated November 15, 1890, a project for the completion of the work of improvement was submitted on November 20, 1890. It provided for the commencement of the improvement by the execution of the work specified in the projects of July 16 and November 15, 1890, and for its continuation under future appropriations by dredging in localities to be determined from time to time in accordance with experience obtained during the progress of the work. This project is appended hereto.

A Board of Officers of the Corps of Engineers, consisting of Col. William P. Craighill, Col. Cyrus B. Comstock, and Maj. Charles W. Raymond, was constituted by Special Orders, No. 80, Headquarters Corps of Engineers, November 24, 1890, to consider and report upon a project for this improvement, and to prepare specifications for the work. The Board met in Philadelphia on November 29, 1890, Colonel Comstock being absent on other duty. A letter of instructions from the Chief of Engineers, dated November 25, 1890, with accompanying papers, was considered, and the Board submitted its report on the same date. The Board recommended the project of November 20, 1890, for approval, and submitted specifications for the work.

The project of November 20, 1890, and the specifications of the Board, slightly amended, were approved December 4, 1890. The report of the Board and its letter of instructions, with the accompanying papers, are appended hereto.

The specifications conformed to the project of November 20, 1890, and required the bidders to state (1) a price per cubic yard for material excavated, and deposited at places provided by the contractor and approved by the engineer officer in charge; (2) a price per cubic yard for material excavated and deposited on League Island; (3) a price per linear foot for the removal of the timber revetment; and (4) the plant which they propose to employ in the work.

Under the instructions of the Chief of Engineers, dated January 23, 1891, the specifications were modified by introducing in the above requirements, after the words *League Island*, the following:

> (2½) a price per cubic yard for spreading said material upon League Island at such places as may be required by the Navy Department not outside of the limits shaded upon the map to be seen in this office.

Proposals for the work were opened on February 12, 1891, and submitted to the Department on the same date, with a letter recommending the award to the lowest bidder. This letter is appended hereto.

The sundry civil act approved March 3, 1891, appropriated $300,000 for continuing the improvement, with the following provisions :

> *Provided*, That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may consider desirable, and the material to be removed from said islands and shoals under this appropriation and appropriations heretofore made shall be deposited and spread on League Island and to the extent of the cost of such deposit and spreading the said appropriations are hereby made available: *Provided further*, That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter.

In view of these provisions I suggested to the Department, under date of March 5, 1891, the advisability of reconsidering the whole project for the improvement, with reference to the new conditions, before the award of any contract for the commencement of the work. The letter of March 5, 1891, giving the reasons for this recommendation, is appended hereto.

On March 7, 1891, the project for the improvement was modified by the War Department by changing the boundary of the part of Petty Island to be removed, with the proviso "That the title to any additional lands acquired for the purpose shall be vested in the United States without charge to the latter."

Under instructions of the Department dated March 6, 1891, a revised project for the completion of the improvement, including a project for the application of the funds available, was submitted on March 14, 1891. This project set forth the considerations which it was believed should control the progress of the improvement and indicated the limits of the work which it was thought safe to do with the funds available under the disadvantageous conditions imposed by the act of March 3, 1891. The work thus proposed was as follows:

1. The removal of the piling at the lower end of Windmill Island and the revetments along its east and west fronts.
2. The removal of Windmill Island by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside the island, except where a less depth may be required by the engineer officer in charge.
3. The removal of the revetment on the south side of the canal between Windmill and Smith Islands.

This work was estimated to cost $200,000. It was proposed to hold the unallotted balance of $490,000 subject to the submission of a future project for its application, so as to conform as closely as possible to the plan of improvement to be determined during the progress of the work. This project is appended hereto.

Under instructions of the Department dated March 18, 1891, all the bids opened on February 12, 1891, were rejected, by authority contained in the indorsements on my letter of February 12, 1891, which is appended hereto.

The project of March 14, 1891, so far as relates to the final recommendations for work to be done with the funds available, was approved by letter of the Chief of Engineers dated March 19, 1891, which is appended hereto.

Specifications in accordance with this project were prepared under the direction of the Chief of Engineers, and submitted to the Department on March 14, 1891.

Under date of April 23, 1891, a contract was entered into with James A. Mundy & Co., of Philadelphia, Pa., for all the work required for the improvement. It provides for the execution of the work at the following rates:

(1) For all material excavated and deposited at places provided by the contractor and approved by the engineer officer in charge, for the entire improvement of Philadelphia Harbor, as per plan approved by Congress, at 10⅞ cents per cubic yard, measured in the scows.

(2) For all pile and timber wharfing or revetment removed, at $1.90 per linear foot of wharfing or revetment.

(3) For all dredged material deposited and spread upon League Island, said price to be in addition to the price per cubic yard under item (1), at 9½ cents per cubic yard, measured in the scows.

The quantity of material to be deposited and spread upon League Island is assumed in the specifications as 2,500,000 cubic yards, but the right is reserved to require an additional amount of material, not exceeding 5,500,000 cubic yards, to be thus disposed of, should future legislation so require.

During the past fiscal year a detailed survey was in progress covering 8 miles of river between Fishers Point, New Jersey, and Greenwich Point, Pennsylvania. Under the contract with James A. Mundy & Co., above referred to, 10,318 cubic yards of material were removed from Windmill Island and deposited alongside of the dike at League Island, preparatory to placing it upon the island. Work has also been in progress in the removal of 1,260 linear feet of revetment inclosing the lower part of Windmill Island.

The Board of Harbor Commissioners of the city of Philadelphia have now under consideration the subject of the reconstruction of the water front of the city in conformity with the project for the improvement and the harbor lines recently established by the War Department. An act of the legislature of the State of Pennsylvania, dated June 8, 1891, passed upon recommendations of the commissioners made through the city councils, empowers the city authorities to extend the local lines during the progress of the improvement. A copy of this act is appended hereto.

On February 13, 1891, I accepted the position of consulting engineer to the Board of Harbor Commissioners, the service to be rendered without compensation.

The commercial statistics pertaining to this work are included in the statistics accompanying the report for improvement of Delaware River.

This work lies in the collection district of Philadelphia, at which, as a port of entry, there was collected during the year ending December 31, 1890, revenue to the amount of $27,572,351.53. The nearest fort and light-houses are, respectively, Fort Mifflin and Schuylkill River range lights.

Total appropriations to June 30, 1891	$1,000,000.00
Total expenditures to June 30, 1891	310,026.08
Total appropriations under present project to June 30, 1891	700,000.00
Total expenditures under present project to June 30, 1891	10,026.08

Money statement.

July 1, 1890, balance unexpended	$199,822.09
Amount appropriated by act approved September 19, 1890	200,000.00
Amount appropriated by sundry civil act approved March 3, 1891	300,000.00
	690,822.09
June 30, 1891, amount expended during fiscal year	9,848.17
July 1, 1891, balance unexpended	689,973.92
July 1, 1891, amount covered by uncompleted contracts	689,973.92
Amount (estimated) required for completion of existing project	2,800,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Philadelphia Harbor, Pennsylvania, for removal of Smith and Windmill Islands, opened September 16, 1890, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantities.			Amount.
		Depositing, at places provided by contractor, 500,000 cubic yards.	Depositing, at or near League Island, 500,000 cubic yards.	Removal of pile or timber wharfing or revetment, 10,000 linear feet.	
		Per cubic yard.	*Per cubic yard.*	*Per linear foot.*	
1	American Dredging Company, Philadelphia, Pa	$0.16¾	$0.16¾	$4.00	$207,500
2	Frank C. Somers, Camden, N. J	.23	.21	4.40	264,000
3	The Penn Dredging Company, Philadelphia, Pa	.17	.15	2.50	185,000
4	Baltimore Dredging Company, Baltimore, Md	.22¼	.20¼	4.50	257,500

Total amount of each bid estimated on supposition that 500,000 cubic yards will be deposited at or near League Island.

All bids rejected in view of new legislation.

Abstract of proposals for removal by dredging of about 17,000,000 cubic yards of material and about 18,000 linear feet of timber work in the improvement of the harbor of Philadelphia, opened February 12, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Project of Board of Engineers of 1888.			League Island.	
		Excavating and removing material, 17,000,000 cubic yards.	Removal of pile and timber wharfing or revetment, 18,000 linear feet.	Amount of bid.	Depositing material upon League Island.	Spreading material upon League Island.
		Per cubic yd.	*Per lin. ft.*		*Per cubic yd.*	*Per cubic yd.*
1	Penn Dredging Company, Philadelphia, Pa.	$0.14 9/10	$2.97½	$2,586,550	$0.23 4/10	$0.01 8/10
2	National Dredging Company, Wilmington, Del.	.14 9/10	3.25	2,591,500	.25½	.2½
3	American Dredging Company, Philadelphia, Pa.	.12½	1.90	2,159,200	.22	.18

Cost of the work as estimated by the Board of Engineers of 1888, $3,500,000.

All bids rejected in view of new legislation changing conditions under which the improvement is to be executed.

Abstract of proposals for removal by dredging of about 18,000,000 cubic yards of material, and about 18,000 linear feet of timber work in the improvement of the harbor of Philadelphia, opened April 9, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Excavating and removing material, 18,000,000 cubic yards.	Removal of pile and timber wharfing or revetment, 18,000 linear feet.	Additional price for depositing and spreading material upon League Island, 2,500,000 cubic yards.	Amount.
		Per cubic yard.	*Per linear foot.*	*Per cubic yard.*	
1	James A. Mundy & Co., Philadelphia, Pa	$0.10⅞	$1.90	$0.09½	$2,229,200
2	The Penn Dredging Company, Philadelphia, Pa	.16¾	2.25	.24½	3,668,000
3	American Dredging Company, Philadelphia, Pa	.15½	1.90	.23¾	3,417,950

Cost of the work as estimated by the Board of Engineers of 1888, not including the depositing of material on League Island and the additional excavation on Petty Island, authorized by the sundry civil act of March 3, 1891, $3,500,000.

Contract (dated April 23, 1891) entered into with James A. Mundy & Co. In progress.

PROJECT FOR COMMENCEMENT OF THE WORK OF IMPROVING THE HARBOR OF PHILADELPHIA.

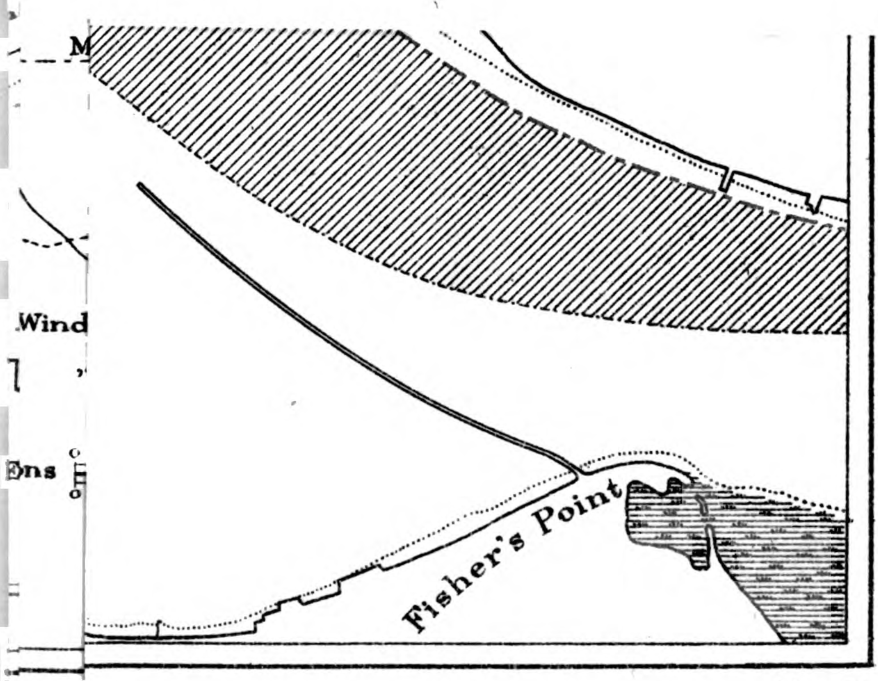
UNITED STATES ENGINEER OFFICE,
Philadelphia Pa., July 16, 1890.

GENERAL: In compliance with instructions contained in your letter of June 4, 1890, I have the honor to submit the following project for the application of the amount appropriated in the river and harbor act of August 11, 1888, for improving harbor of Philadelphia, and the amount appropriated in the naval act of March 2, 1889, for navy-yard, League Island, Pennsylvania; dredging and filling in.

The act of August 11, 1888, appropriates the sum of $500,000 "for the removal of Smith Island and Windmill Island, in the State of Pennsylvania, and Petty Island, in the State of New Jersey, or such parts of them and the shoals adjacent thereto as may be required, and for the improvement of the harbor between the cities of Philadelphia, Pa., and Camden, N. J." Of the sum thus appropriated $300,000 have already been expended, under the orders of the Department, in the acquisition of title to the lands to be removed, leaving $200,000 available for the work of improvement.

The act of March 2, 1889, appropriates the sum of $75,000 for dredging and filling in at the navy-yard, League Island, Pennsylvania, and provides that "in the expenditure of this sum the Secretary of the Navy may coöperate with the Secretary of War and utilize any earth that may be removed from adjacent waters under appropriations made by Congress."

The general project which forms the basis of these appropriations is contained in the report of a Board of Engineers constituted by Special Orders No. 14, Headquarters Corps of Engineers, dated March 10, 1888, in accordance with the joint resolution of Congress of February 17, 1888. The report is dated March 30, 1888, and is published in the Annual Report of the Chief of Engineers for 1888, page 679.



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This project contemplates the formation of a channel about 2,000 feet in width with a cross section not far from 55,000 square feet at mean tide along the Philadelphia shore from opposite Kaighn Point to opposite Fishers Point, at a distance far enough from the present wharf line, not exceeding about 300 feet, to permit the extension of the wharves and the widening of Delaware avenue at their shore ends. For this purpose it is proposed to remove Smith and Windmill Islands and the adjacent shoals so as to form a 26-foot channel, about 1,000 feet wide, or wider if found practicable during the progress of the work, along the revised Philadelphia wharf line from Kaighn Point to the foot of Petty Island.

The project further contemplates the ultimate improvement of the Pennsylvania Channel at Petty Island by increasing its width to about 2,000 feet and giving it a cross section of about 55,000 square feet at mean tide, so as to enable it to carry the whole tidal flow of the river. This is based upon the assumption that the thorough improvement of Five-Mile Bar will ultimately require the closure of the New Jersey Channel south of Petty Island; but the Board remarks that until this complete closure has been effected the enlargement of the north channel to its ultimate dimensions will not be necessary, the only indispensable condition being to leave a combined water way through the two channels which will not decrease the tidal prism above Petty Island.

The most immediate benefits to commerce to be derived from this improvement will result from the removal of Smith and Windmill Islands and the adjacent shoals, which narrow the channels between Philadelphia and Camden, obstruct communication between these cities, and prevent extension of the wharves. It is therefore desirable to commence the work by removing these obstructions to such extent as may be justified by existing physical conditions. The Board of 1888 remarks that the removal of these islands "should not begin or be carried on without the simultaneous regulation of the port wardens lines of both shores of the river, so as to maintain the assigned section of the new channel, as a failure in this respect would only be followed by the re-formation of these islands in whole or in part by the river. Moreover, it is not sufficient that these lines should simply be laid down on paper, but their existence as actual constructions should be a part of the progressive scheme for the proper improvement of the river."

The establishment of the harbor lines for the port of Philadelphia is now under consideration by the Board of Engineers, constituted by Special Orders No. 20, Headquarters Corps of Engineers, dated February 25, 1889, and these lines will doubtless be definitely located before the completion of preparations for the commencement of the work of removing the islands. While the actual construction along the new wharf lines is not under the control of the General Government, it is believed that the views of the Board will be fully met if the removal of the islands and shoals is not permitted to progress more rapidly than is justified by the extension of wharves or other changes in the existing conditions. It is evident that great injury might follow a too rapid advance of the wharves, but this can be readily controlled through the agency of the board of port wardens of Philadelphia.

In order to determine where it is best to commence the work of excavation and to what extent it may be safely carried at the present time, it is desirable to consider the history of this system of islands and shoals and the physical conditions connected therewith. The information necessary for this purpose is found in the maps of 1762, 1819, 1843, 1878, and 1882. The report of Mr. H. C. Marindin in the Annual

Report of the U. S. Coast Survey for 1885 is accompanied by numerous cross sections of the harbor, showing the comparative conditions of the channels in 1819, 1843, and 1878. Reports connected with this subject by Prof. Henry Mitchell and Lieutenant-Colonel Robert will be found in the Annual Report of the Chief of Engineers for 1888, Part I, pp. 720–724. The unpublished diagrams accompanying Colonel Robert's report give the comparisons for more recent surveys. All these papers are of great value in the investigation.

These islands and the adjacent bars originally constituted a long shoal, just awash or partly dry at low water. In 1762 Windmill Island extended from opposite the foot of Christian street to opposite the foot of Pine street, with a series of low bars projecting from its head to about the present position of Cooper Point. In 1819 both ends of the island had moved up the river about 1,000 feet, the upper end being opposite Chestnut street, and a shoal had developed between the prolongations of Market and Vine streets. About 1839 a canal was cut through a depression across the upper end of the island. Thus Smith Island was formed, and in 1843 it was protected by wharfing and reduced to about its present shape. A dry shoal described as 2 or 3 feet above low water extended from its upper end to about opposite Race street. About 1868 Windmill Island assumed its present shape and was protected by wharfing. Between 1843 and 1868 the lower end was cut away about 300 feet and the size of the adjacent shoal was greatly reduced. In this interval the shoal at the head of Smith Island receded at the upper end about 500 feet. Between 1868 and 1882 the reduction of the Windmill Island Shoal continued down to the 18-foot curve, the flank of the shoal being cut away, and the dry shoal above Smith Island entirely disappeared to a depth of about 3 feet at low water.

The islands above the plane of low water are artificial constructions. Throughout the whole extent of their shore lines they are protected by bulkheads from the action of the currents; but the shoals above and below them are the results of the action of natural forces only, and the study of their changes under the influence of varying conditions is therefore of importance in determining the changes which will probably take place while the islands are being removed.

The circumstances which have apparently been most influential in producing changes in the positions and dimensions of these shoals are the great advance of the wharf lines on both sides of the river between 1843, and 1878, the contraction of the Pennsylvania Channel at Petty Island by the construction of wharves on both sides between 1843 and 1883, and the construction of the Fishers Point dike between 1885 and 1890. The shoal south of Windmill Island rapidly decreased until the island shore was held by revetment in 1868. Its reduction in volume has continued since that time, but at greatly diminished rate. I find no evidence that the contraction of the Pennsylvania Channel at Petty Island has had any effect upon it. Indeed the most striking feature in the history of this shoal is its continued loss of volume under all changes of physical conditions. The shoal north of Smith Island, however, has exhibited changes less uniform in character. Between 1843 and 1883 it shifted westerly under the influence of the contraction of the Pennsylvania Channel at Petty Island, the depth of water being much decreased, while between 1883 and 1890 it has moved to the eastward again and lost materially in volume under the influence of the Fishers Point Dike.

The advance of the wharves on the Philadelphia shore produced its principal effect in deepening the channel near the pierheads, yet it has removed a large amount of material from both shoals, especially above the 20-foot plane. The rapid current which flows during the ebb towards the Camden shore through the canal between the islands suggests the probability of a considerable scour when the shore revetments of the islands are removed. The effect of wharf advance on the Camden shore has been more general across the whole water way, and its influence in reducing the volumes of the shoals has been much greater. All the surveys show that the effects of changes in the shore lines have been very marked above the 10-foot plane when unopposed by revetments.

The portions of Smith and Windmill Islands above the plane of 8 feet below low water, the least depth to which the excavation can be economically made, contain about 1,000,000 cubic yards of material, which, it is believed, can be removed with the funds now available. It appears from the above discussion that if this is done the action of natural forces may be expected to largely diminish the volume of the lower end of the southern shoal. I am informed that as soon as the harbor lines are definitely located a large part of the Camden water front will be bulkheaded along the advanced line, and the extension of the wharves on the Philadelphia shore may be expected to commence at the northern end of the new line. It is probable that these changes, in connection with the eastward direction of the ebb currents, will be of sufficient extent to hold in check any tendency towards the reformation of the islands above the 8-foot curve. This tendency will in any event be very limited, since the waters of the Delaware carry little or no material in suspension and the movements of sand along its bed are small. If, however, it is found by observation, after the completion of the work, that shoaling occurs beyond the control of the shore constructions, an efficient remedy is at hand in the application of the funds next available to the widening of the Pennsylvania Channel opposite the lower end of Petty Island, and, if necessary to the complete closure of the New Jersey Channel, by the extension of the Fishers Point Dike.

The commencement of the work by the removal of Smith and Windmill Islands to the depth above indicated seems to be further justified by a study of portions of the channel volumes computed from the surveys of 1819, 1843, and 1878. These volumes are included between vertical planes perpendicular to the axis of the river at the ends of the area over which it is now proposed to dredge, and between the planes of mean low water and 8 feet depth. The following table gives approximately the channel or water way volumes, the volumes of the islands, and the complete volumes across the river within the above limits.

Year.	Channel volume.	Volume of islands.	Volume, including islands.
	Cubic feet.	*Cubic feet.*	*Cubic feet.*
1819	93,000,000	25,000,000	118,000,000
1843	88,500,000	20,000,000	108,500,000
1878	78,000,000	15,000,000	93,000,000

These figures show that from 1819 to 1878 the channel volume was rapidly reduced by the advance of wharves on both sides of the river. The island volumes were also reduced, the reduction during the interval of 24 years between 1819 and 1843 being as large as that in the interval of 35 years between 1843 and 1878, doubtless because in the latter period the island shores were much more thoroughly revetted. Finally, it appears that in 1819 the river had a channel volume about equal to that which it would have had in 1878 with the islands removed to a depth of 8 feet, and this volume it maintained, not only without shoaling, but with decided indications of its power to create and preserve a still larger channel volume at the same level if unresisted by revetments. It is true that in the interval between 1843 and 1878 the power of the working forces was considerably reduced by the contraction of the channel north of Petty Island, as is shown by the increase in volume of the Smith Island Bar during that period; but since the construction of the Fishers Point Dike this shoal has been reduced to about the same dimensions it had in 1843, and there is no reason to believe that the unrestricted energy of the river would be now less effective than in 1819. It seems, therefore, reasonable to conclude that if the islands are removed to the depth proposed, the river will maintain the new channel volume, as it did in the year last mentioned.

It is desirable to commence the excavation in the canal within the interior of Windmill Island, the southern end of the island with its revetments being first removed, so as to afford unobstructed action to the natural forces. The cut should be extended northward to the canal between the two islands, and finally Smith Island should be removed. Two other methods of procedure have been considered; first, to commence the excavation along the western shore of the islands so as to give early relief to the contracted Philadelphia Channel; and, second, to begin by widening the canal separating the islands, so as to afford freer ferry communication between the cities. The first plan is rejected because the work of the dredges would be much retarded by the wash of passing steamers, and the second because the dredges would obstruct the passage of ferryboats during the execution of the work. By the commencement of the work as above proposed, the dredges will be completely protected from the disturbing action of waves, and when the excavation at Windmill Island is finished, freedom of communication between the two cities will be greatly increased.

I have endeavored to obtain as much information as possible regarding locations for the disposition of the material to be removed. All the places considered, except League Island, are contingent upon arrangements with private parties. The most available locality for the reception of a large amount of material is behind the bulkhead which I am informed is to be constructed along the Camden shore. I am of the opinion that no price will be offered for this material, but I believe free dumping ground may be obtained from parties who will undertake to remove it.

An examination made at League Island shows that there are convenient places along the shore where material can be dumped and from which it can be readily transferred to the surface of the island, and I believe it can be delivered there as cheaply as at any other locality. It seems, therefore, desirable to apply the entire sum of $75,000, approated in the naval act of March 2, 1889, to the rehandling of material to be deposited at League Island during the progress of the work. The probability of an abundant supply of material in the near future justifies the purchase of plant suitable for this purpose, and as the cost of such plant will consume a considerable part of the appropriation, only a comparatively small portion of the material removed with funds now available can be disposed of at League Island. I respectfully suggest that the funds appropriated in the naval act of March 2, 1889, can be most conveniently disbursed by the naval authorities, the work of filling in to be under their control, and the duty of this office to be confined to the supply of material as it may be required.

In accordance with the views above expressed, I have the honor to recommend as follows:

1. That the sum of $200,000, being the amount remaining unexpended from the funds appropriated in the river and harbor act of August 11, 1888, for improving the harbor of Philadelphia, be applied to the removal of Smith and Windmill Islands to a depth of about 8 feet below mean low water; the work to be done by contract after advertising 30 days for proposals; and the contract to contain the condition that such part of the material excavated as the Engineer officer in charge may direct shall be dumped at suitable places at or near League Island navy-yard.

2. That the sum of $75,000 appropriated in the naval act of March 2, 1889, for dredging and filling in at the navy-yard, League Island, be applied, under the direction of the naval authorities, to placing in the yard material dumped at League Island under the contract above recommended.

A plan showing the limits of the work proposed is transmitted herewith.*

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

AMENDMENTS AND APPROVAL OF PROJECT OF JULY 16, 1890.

OFFICE OF THE CHIEF OF ENGINEERS,
U. S. ARMY,
Washington, D. C., July 28, 1890.

MAJOR: Your communication of the 16th instant, submitting project for the application of the unexpended balance of the appropriation of August 11, 1888, for improving harbor of Philadelphia, and the amount appropriated in the naval act of March 2, 1889, for dredging and filling in at the navy-yard, League Island, Pennsylvania, was duly received at this office and submitted to the Secretary of War, with indorsement, of which the following is a copy:

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 23, 1890.

Respectfully submitted to the Secretary of War.

This project for the expenditure of the $200,000 available for improving the harbor of Philadelphia, submitted by Major Raymond and approved by the division engineer, Colonel Craighill, meets with my approval, with the following exceptions:

That in asking for bids Major Raymond shall ask—

First. For a price per cubic yard, dumping to be at the discretion of the contractor

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* Omitted. See general sketch.

(provided, of course, the material is not placed so as to injure the navigable channels).

Second. For a price per cubic yard, the dumping to be along the shore of League Island.

Third. That after the contract is awarded, specifying the quantity to be dumped at League Island, the difference in prices between dumping, as the contractor may choose, and the dumping along the shores of League Island, shall be paid by the Navy Department from the $75,000 appropriated for filling at League Island.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

The project has been returned from the War Department indorsed as follows:

[Third indorsement.]

WAR DEPARTMENT, *July 24, 1890.*

The recommendations of the Chief of Engineers are approved.

L. A. GRANT,
Acting Secretary of War.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

MAJ. C. W. RAYMOND,
Corps of Engineers.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
BALTIMORE, MD., *July 29, 1890.*

Respectfully transmitted to Maj. C. W. Raymond, Corps of Engineers, U. S. A.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

PROJECT FOR THE EXPENDITURE OF THE SUM OF $200,000 APPROPRIATED IN THE RIVER AND HARBOR ACT OF SEPTEMBER 19, 1890, FOR IMPROVING THE HARBOR OF PHILADELPHIA—CONTINUING IMPROVEMENT.

UNITED STATES ENGINEER OFFICE,
PHILADELHPIA, PA., *November 15, 1890.*

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following project for the expenditure of the sum of $200,000 appropriated in the river and harbor act of September 19, 1890, for improving the harbor of Philadelphia. For removal of Smith Island and Windmill Island, in the State of Pennsylvania, and Petty Island, in the State of New Jersey, or such parts of them and the shoals adjacent thereto as may be required, and for the improvement of the harbor between the cities of Philadelphia, Pa., and Camden, N. J.

A project for the commencement of this improvement, providing for the expenditure of funds then available, was submitted to the Department on July 16, 1890, and was modified and approved by Department letter of July 28, 1890. It provides for the removal of Smith and Windmill Islands to a depth of about 8 feet below mean low water.

After this work has been completed, it is recommended that the dikes which revet the cut across the shoal north of Smith Island be removed in order to expose the dredged area to the full scouring action of the currents. This work is estimated to cost about $10,000. It is further recommended that the remaining sum of $190,000 be applied to the removal of the wharfing along the north front of Petty Island and the dredging of about 1,000,000 cubic yards of material from the same front, the cut to be outside of the existing earthen dike and extend to a depth not exceeding 8 feet at mean low water. The object of this proposed work is to increase the width of the water way so as to facilitate the tidal flow and thus assist in the maintenance of the depths obtained by dredging at Smith and Windmill Islands.

It is proposed to do the work by contract after advertising for proposals, such method being considered most economical and advantageous to the Government. The detailed conditions under which the work is to be done will, it is presumed, be provided for in the specifications to be prepared by the Board of Engineers referred to in Department letter of September 22, 1890.

The location of the work above recommended is shown on the tracing herewith transmitted.*

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

PROJECT FOR COMPLETION OF THE WORK OF IMPROVING THE HARBOR OF PHILADELPHIA, IN ACCORDANCE WITH THE PROVISIONS OF THE RIVER AND HARBOR ACT OF SEPTEMBER 19, 1890.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 20, 1890.

GENERAL: In compliance with instructions contained in Department letter of November 15, 1890, I have the honor to submit the following project for the completion of the work of improving the harbor of Philadelphia, in accordance with the provisions of the river and harbor act approved September 19, 1890.

The provisions referred to are as follows:

> Improving the harbor of Philadelphia: For removal of Smith Island and Windmill Island, in the State of Pennsylvania, and Petty Island, in the State of New Jersey, or such parts of them and the shoals adjacent thereto as may be required, and for the improvement of the harbor between the cities of Philadelphia, Pa., and Camden, N. J., $200,000: *Provided*, That contracts may be entered into by the Secretary of War for the work required for the improvement of the Delaware River between the cities of Philadelphia, Pa., and Camden, N. J., according to the plan reported by the Board of Engineers and transmitted to Congress April 7, 1888, and printed as House Ex. Doc. No. 260, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided*, That the cost of the improvement shall not be thereby increased, to be paid for as appropriations may from time to time be made by law.

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* Omitted. See general sketch.

GENERAL PROJECT.

The plan of the Board of Engineers of 1888, referred to in the act, contemplates the formation of a channel about 2,000 feet in width, with a cross-section not far from 55,000 square feet, at mean tide, along the Philadelphia shore from Kaighn Point to Fishers Point, at a distance far enough from the present wharf line, not exceeding about 300 feet, to permit the extension of the wharves and the widening of Delaware avenue at their shore ends.

For this purpose it is proposedto remove Smith and Windmill Islands and the adjacent shoals so as to form a 26-foot channel, about 1,000 feet wide or wider if found practicable during the progress of the work, along the revised Philadelphia wharf line, from Kaighn Point to the foot of Petty Island. It is further proposed to widen the Pennsylvania Channel at Petty Island so that the combined waterway through the north and south channels shall be sufficient to prevent a decrease of the tidal prism above, and when the complete closure of the New Jersey Channel becomes necessary for the thorough improvement of Five Mile Bar, to give the Pennsylvania Channel in this locality a width of about 2,000 feet, a depth of 26 feet over a width of 1,000 feet, the channel sloping to a depth of 12 feet in the remaining width, and a resulting cross-section of about 55,000 square feet, so as to enable it to carry the whole tidal flow of the river.

The material removed is to be placed where it will not be an injury to the river. The rate of progress of the work of excavation is to be determined by the rate of advance of actual wharf constructions to the new harbor lines, so as to maintain the assigned section of the new channel. The Board estimates the cost of the dredging to be ultimately done to carry out its plan at $3,500,000. This project is subject to modification by the Secretary of War, provided such modification does not increase the cost of the improvement.

DESCRIPTION OF THE LOCALITY.

Smith and Windmill Islands are situated in the Delaware River between and opposite the centers of the cities of Philadelphia and Camden. They are about 800 feet from the ends of the Philadelphia wharves and about 1,200 feet from the ends of the Camden wharves. The islands are separated by a cut about 130 feet wide and about 10 feet deep at mean low water, which is maintained by a ferry company.

The combined length of the two islands is about 2,600 feet. The area of Smith Island is about 8 acres and that of Windmill Island is 17 acres. Above Smith Island there is a shoal extending about one mile and having on it less than 6 feet at mean low water; and below Windmill Island there is a shoal having on it a depth of less than 12 feet at mean low water for a distance of about one-half a mile.

Both islands are inclosed by a revetment of crib work, piling, and wharves, generally backed with stones; the channel between them is revetted with piles and a revetment of piles, intended to prevent erosion, extends down stream for a distance of 500 feet from the south end of Windmill Island. Just north of the head of Smith Island there is a cross channel revetted on both sides by pile dikes filled with stones and gravel. The surface of the islands averages about 9 feet above mean low water and about 3 feet above mean high water, and is well covered with trees.

These islands and their adjacent bars were originally a long shoal just awash or partly dry at low water, and above the plane of low water they are artificial constructions. The upper filling consists principally of dredged material from the wharves of the adjacent cities and ballast from vessels. Below low water the material is supposed to be sand and gravel.

Forty-three borings were made in the Delaware River between Kaighn Point and Cooper Point in 1874, for a bridge company, and it appears that rock was not encountered at a depth less than 39 feet below low water, and on the bar just above Smith Island it was only reached at a depth of over 100 feet. Thirty-three borings were made in 1883 on Smith, Windmill, and Petty Islands by the engineers of the United States, and no rock was reached at a depth of 24 feet, which was the greatest depth of boring. From this evidence it is assumed that no removal of rock will be required in the execution of the projected work.

Petty Island is situated about 2 miles above the head of Smith Island, the two being almost connected by shoals. It is about 2 miles long and has an area of about 360 acres. Its surface is below the plane of high water and it is protected from overflow by earthen dikes. The plan of improvement contemplates the removal of a part of the northern side of the island containing about 85 acres above mean low water. This part of the island is the property of the United States and its limits are indicated on the tracing herewith.

A part of the shore line is protected by wharves and timber revetment which are to be removed. The material to be excavated is supposed to be similar to that in the other islands. The material to be removed from the channel between the upper part of Petty Island and the Philadelphia shore is shown by previous dredging to be coarse gravel mixed with bowlders, but no bowlders have been found too large to be easily removed by dredging. The extent of this hard material is not definitely known.

The working season for dredging in this locality is generally considered to extend from about April 1 to December 31, but in an open season work may often be prosecuted to advantage during the winter and early spring. The mean range of the tide is about 6 feet.

CONDITIONS OF THE WORK.

The work required for the complete execution of this project is as follows:

1. The removal of all trees, structures, machinery, and other artificial material of whatever nature upon the islands, this work to be done without expense to the United States.

2. The removal of the pile and timber wharfing or revetment which surrounds Smith and Windmill Islands and the interior basin of the latter, and extends along the northern shore of Petty Island, and the removal of the timber work of the dikes which form the cross-channel north of Smith Island, and the projecting piles south of Windmill Island. The aggregate length of this timber work is about 18,000 feet. This material is to be entirely removed and so disposed of as not to injure vessels or obstruct navigation.

3. The removal by dredging and by the natural scour of the tidal currents of about 17,000,000 cubic yards of material, including any material deposited in the channel by the action of the currents during the progress of the work, at any point between Kaighn Point and Fishers

Point. The dredged material is to be deposited in the vicinity of the Mifflin Bar Dike, at the League Island navy-yard, or at such other places as may be indicated or approved by the engineer officer in charge. It is proposed to do this work in the order above indicated, by contract, after due advertisement for proposals, in accordance with specifications to be prepared by the Board of Engineers referred to in Department letter of September 22, 1890, this method being considered most economical and advantageous for the Government.

COMMENCEMENT OF THE WORK.

The funds now available for this improvement consist of about $190,000, remaining from the amount appropriated in the act of August 11, 1888, and $200,000 appropriated in the act of September 19, 1890, making a total of $390,000. A project covering the application of the sum first mentioned was submitted to the Department on July 16, 1890, and was approved by Department letter of July 28, 1890. A project for the application of the second appropriation was sent to the Department, through the division engineer, on November 15, 1890.

These projects provide for the execution of the work as follows:

1. The piling at the lower end of Windmill Island and the revetment along the east and west fronts of the island will be removed. The approximate length of this piling and revetment is 7,500 feet.
2. Windmill Island will be removed by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside of the island, except where a less depth may be required by the engineer officer in charge. The approximate amount of material to be removed is 700,000 cubic yards.
3. The revetment of the canal between the islands and the revetment inclosing Smith Island will be removed. The approximate length of this revetment is 2,500 feet.
4. Smith Island will be removed by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside the island, except where a less depth may be required by the engineer officer in charge. The approximate amount of material to be removed is 300,000 cubic yards.
5. The revetment of the cross-channel north of Smith Island will be removed. The approximate length of this revetment is 1,000 feet.
6. The revetment along the north shore of Petty Island will be removed. The approximate length of this revetment is 7,000 feet.
7. The funds remaining after the work above described has been executed will be applied to dredging about 1,000,000 cubic yards of material from the north front of Petty Island, the cut to be outside of the existing dike and extend to a depth not exceeding 8 feet below mean low water.

Material on the surface of the islands is to be removed by the contractor without expense to the United States at any time during the progress of the work.

The exact location of dredging to be done under future appropriations will be determined from time to time in accordance with experience obtained during the progress of the work.

In compliance with instructions contained in Department letter of September 22, 1890, detailed specifications for the prosecution of this work have been prepared for submission to the Board of Officers of the Corps of Engineers therein referred to.

A tracing showing the location and general character of the work is transmitted herewith.*

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF THE BOARD OF ENGINEERS ON THE PROJECT AND SPECIFICATIONS SUBMITTED BY MAJOR C. W. RAYMOND, CORPS OF ENGINEERS, FOR COMPLETING THE IMPROVEMENT OF PHILADELPHIA HARBOR, PENNSYLVANIA.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 29, 1890.

GENERAL: The Board constituted by your orders of November 24, 1890, and acting under your instructions of November 25, 1890, to consider the project and specifications submitted by Maj. C. W. Raymond, Corps of Engineers, for completing the improvement of Philadelphia Harbor, Pa., under the provisions of the river and harbor act of September 19, 1890, and to prepare specifications for the work, met in this city November 28th, Colonel Comstock being not present.

The provision of the act of September 19, 1890, relating to the harbor is the following:

> Improving the harbor of Philadelphia: For removal of Smith Island and Windmill Island, in the State of Pennsylvania, and Petty Island, in the State of New Jersey, or such parts of them and the shoals adjacent thereto as may be required, and for the improvement of the harbor between the cities of Philadelphia, Pennsylvania and Camden, New Jersey, two hundred thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for the work required for the improvement of the Delaware River between the cities of Philadelphia, Pennsylvania and Camden, New Jersey, according to the plan reported by the Board of Engineers and transmitted to Congress April seventh, eighteen hundred and eighty-eight, and printed as House Executive Document two hundred and sixty, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided*, That the cost of the improvement shall not be thereby increased, to be paid for as appropriations may from time to be made by law.

The naval appropriation act of March 2, 1889, contains the following item:

> Navy-yard, League Island, Pennsylvania: * * * dredging and filling in, seventy-five thousand dollars, and in the expenditure of this sum the Secretary of the Navy may coöperate with the Secretary of War and utilize any earth that may be removed from adjacent waters under appropriations made by Congress.

The extent of the coöperation desired by the Navy Department is indicated by the following specifications which the Acting Secretary of the Navy requests, in his communication of October 3 to the Secretary of War, should be incorporated among the conditions for the performance of the work:

> *Item 1.* Dredged materials in such quantities and at such times as the engineer officer in charge may direct shall be deposited within the limits of the navy-yard League Island, on the island proper, east of Broad street.
>
> The material so deposited may be landed at such points on the dikes east of Broad street and the filled portion of the yard as the contractor may select. First material will be landed and spread out over an area 600 feet wide measured from the Delaware River dike, and beginning at the easterly limit of said fill

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*Omitted. See general sketch.

and extending thence in an easterly direction along said dike, the filling to be sufficiently above the grade of the yard to allow for shrinkage and the work of depositing and spreading to be under the supervision and inspection of the civil engineer of the navy-yard.

Item 2.—The contractor shall have the privilege of depositing material, other than that designated for the island proper of the navy-yard, in the back channel of said yard east of Broad street; provided it is placed and filled to such height not above grade with proper allowance for shrinkage as shall be directed by the civil engineer of the said navy-yard.

The operations of the Engineer Department in this improvement are to be carried on, it would seem, in conformity to the law of September 19, 1890, which prohibits any modification of the project involving an increased cost of the improvement of the harbor beyond a certain fixed limit, and this law is the last expression of the will of Congress on the subject.

It is the opinion of the Board that to require a contractor to comply with the detailed specifications of the Navy Department would materially increase the cost of the work. Nor is it supposed the naval law of March 2, 1889, intended all or any of the expense of the improvement of League Island for naval purposes to fall upon a river and harbor appropriation. Indeed the naval law of March 2, 1889, clearly refers to coöperation in the expenditure of the sum therein appropriated, $75,000, and contemplates only the utilization by the Navy Department of any earth that may be removed from adjacent waters.

The views of the local engineer in his report of November 20, 1890, are recommended for approval. The specifications submitted by him, modified to accord with the instructions of November 25, 1890, from the Chief of Engineers, are also recommended for approval. While not going into the details desired by the specifications from the Navy Department, the specifications of the Board call for a price for material deposited upon League Island and upon the part of the island where that Department wishes it to be placed, and in compliance with the views of the Navy Department so far as the laws seem to justify.

A copy of Major Raymond's report of November 20, 1890, and a copy of his original specifications* are herewith, as also a form of specifications as recommended by the Board.

Respectfully submitted.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers, U. S. A.
C. W. RAYMOND,
Major, Corps of Engineers, U. S. A.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SPECIFICATIONS RECOMMENDED BY THE BOARD OF ENGINEERS.

AUTHORITY FOR THE IMPROVEMENT.

In accordance with a provision of the river and harbor act of September 19, 1890, the work of improving the harbor of Philadelphia will be executed "according to the plan reported by the Board of Engineers and transmitted to Congress April 7. 1888, and printed as House Executive Document No. 260, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided,* That the cost of the improvement shall not be thereby increased, to be paid for as appropriations may from time to time be made by law."

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* Omitted.

GENERAL PROJECT.

The plan of the Board of Engineers of 1888, above referred to, contemplates the formation of a channel about 2,000 feet in width with a cross-section not far from 55,000 square feet at mean tide along the Philadelphia shore from Kaighn Point to Fishers Point, at a distance far enough from the present wharf line, not exceeding about 300 feet, to permit the extension of the wharves and the widening of Delaware avenue at the shore ends.

For this purpose it is proposed to remove Smith and Windmill Islands and the adjacent shoals so as to form a 26-foot channel, about 1,000 feet wide, or wider if found practicable during the progress of the work, along the revised Philadelphia wharf line from Kaighn Point to the foot of Petty Island. It is further proposed to widen the Pennsylvania Channel at Petty Island, so that the combined water way through the north and south channels shall be sufficient to prevent a decrease of the tidal prism above, and when the complete closure of the New Jersey Channel becomes necessary for the thorough improvement of Five Mile Bar to give the Pennsylvania Channel in this locality a width of about 2,000 feet, a depth of 26 feet over a width of 1,000 feet, the channel sloping to a depth of 12 feet in the remaining width, and a resulting cross-section of about 55,000 square feet, so as to enable it to carry the whole tidal flow of the river.

The material removed is to be placed where it will not be an injury to the river. The rate of progress of the work of excavation is to be determined by the rate of advance of actual wharf constructions to the new harbor lines, so as to maintain the assigned section of the new channel. The Board estimates the cost of the dredging to be ultimately done to carry out its plan at $3,500,000. This project is under the law subject to modification by the Secretary of War, provided such modification does not increase the cost of the improvement.

DESCRIPTION OF THE LOCALITY.

The following description and the sketch hereto appended are intended to give a general idea of the character and location of the work required; but bidders are expected to examine the locality and satisfy themselves as to the nature of the material to be removed, the sites for its disposal, and of the work generally, and it will be assumed that their proposals are based upon such personal information.

Smith and Windmill Islands are situated in the Delaware River between and opposite the centers of the cities of Philadelphia and Camden. They are about 800 feet from the ends of the Philadelphia wharves and about 1,200 feet from the ends of the Camden wharves. These islands are the property of the United States. They are separated by a cut about 130 feet wide and about 10 feet deep at mean low water, which is maintained by a ferry company.

The combined length of the two islands is about 2,600 feet. The area of Smith Island is about 8 acres and that of Windmill Island is 17 acres. Above Smith Island there is a shoal extending about 1 mile and having on it less than 6 feet at mean low water; and below Windmill Island there is a shoal having on it a depth of less than 12 feet at mean low water for a distance of about one-half mile.

Both islands are inclosed by a revetment of crib work, piling and wharves, generally backed with stones; the channel between them is revetted with piles, and a revetment of piles intended to prevent erosion extends downstream for a distance of 500 feet from the south end of Windmill Island. Just north of the head of Smith Island there is a cross channel revetted on both sides by pile dikes filled with stone and gravel. The surface of the islands averages about 9 feet above mean low water and about 3 feet above mean high water, and is well covered with trees.

These islands and their adjacent bars were originally a long shoal just awash or partly dry at low water, and above the plane of low water they are artificial constructions. The upper filling consists principally of dredged material from the wharves of the adjacent cities and ballast from vessels. Below low water the material is supposed to be sand and gravel.

Forty-three borings were made in the Delaware River between Kaighn Point and Cooper Point in 1874 for a bridge company, and it appears that rock was not encountered at a depth less than 39 feet below low water, and on the bar just above Smith Island it was only reached at a depth of over 100 feet. Thirty-three borings were made in 1883 on Smith and Windmill and Petty Islands by the engineers of the United States, and no rock was reached at a depth of 24 feet, which was the greatest depth of boring. From this evidence it is assumed that no removal of rock will be required in the execution of the projected work.

Petty Island is situated about 2 miles above the head of Smith Island, the two being almost connected by shoals. It is about 2 miles long and has an area of about 360 acres. Its surface is below the plane of high water and it is protected from overflow by earthen dikes. The plan of improvement contemplates the removal of a part of the northern side of the island containing about 85 acres above mean low water. This part of the island is the property of the United States and its limits are indicated on the sketch hereto appended.

A part of the shore line is protected by wharves and timber revetment which are to be removed. The material to be excavated is supposed to be similar to that in the other islands. The material to be removed from the channel between the upper part of Petty Island and the Philadelphia shore is shown by previous dredging to be coarse gravel mixed with bowlders, but no bowlders have been found too large to be easily removed by dredging. The extent of this hard material is not definitely known.

The working season for dredging in this locality is generally considered to extend from about April 1 to December 31, but in an open season work may be often prosecuted to advantage during the winter and early spring. The mean range of the tide is about 6 feet.

The principal articles on the islands which are to be removed by the contractor and become his property, as hereinafter specified, are as follows:

Smith Island.—Ten buildings, consisting of hotel, 3 dwelling-houses, gas house, ice house, blacksmith shop, bowling alley, and 2 pavilions; also fencing and concrete block pavement.

Windmill Island.—Eight buildings, consisting of a logwood factory, containing 2 boilers, 2 steam-engines, 4 copper extractors, 2 vacuum pans, 1 copper-lined tank, and 1 pulsometer pump; smelting works, containing 1 boiler, 2 steam-engines; 3 dwelling-houses, 2 coal offices, and 1 shed.

Petty Island.—Six buildings, consisting of 3 dwelling-houses, 2 sheds, and 1 carpenter shop.

CONDITIONS OF THE WORK.

The work required for the complete execution of this project is as follows:

1. The removal of all trees, structures, machinery, and other artificial material of whatever nature upon the islands, and belonging to the United States, except the pile and timber wharfing or revetment. This material shall become the property of and be removed by the contractor without expense to the United States, and upon the execution of the contract the responsibility of the United States for its care and preservation shall cease. Notice will be given by the engineer officer in charge to all persons to remove private property from the islands without delay, and all such property remaining upon the islands after the execution of the contract will be at the owner's risk.

2. The removal of the pile and timber wharfing or revetment which surrounds Smith and Windmill Islands, and the interior basin of the latter, and extends along the northern shore of Petty Island, and the removal of the timber work of the dikes which form the cross channel north of Smith Island, and the projecting piles south of Windmill Island. The aggregate length of this timber work is about 18,000 feet. This material is to be entirely removed by the contractor and so disposed of as not to injure vessels or obstruct navigation, and will be paid for at a fixed price per linear foot, measured along the line of the work, the material removed to become the property of the contractor.

3. The removal by dredging and by the natural scour of the tidal currents of about 17,000,000 cubic yards of material. If any material is deposited in the channel by the action of the currents during the progress of the work, at any point between Kaighn Point and Fishers Point, the contractor shall remove it at the contract rate, if directed to do so by the engineer officer in charge.

All dredged material not otherwise provided for is to be deposited by the contractor at localities provided by him and subject to the approval of the engineer officer in charge. The contractor will be permitted to deposit dredge material behind the Mifflin Bar Dike and in the back channel of League Island navy-yard, east of Broad street, subject to regulations made by the engineer officer in charge, who shall designate the places and determine the amount of such deposit. Mifflin Bar Dike is about 10 miles below Windmill Island. The stone filling behind the revetments and in the dikes north of Smith Island will be deposited by the contractor in the gap between Fishers Point Dike and the east end of Petty Island, and will be paid for as dredged material.

Dredged material in such quantities and at such times as the engineer officer in charge may direct shall be deposited within the limits of the navy-yard, League Island, on the island proper, east of Broad street. The material so deposited may be landed at such points on the dikes east of Broad street and the filled portion of the yard as the contractor may select. The total amount of material to be deposited upon League Island, if any, will not exceed 6,400,000 cubic yards.

Dredging will be paid for by the cubic yard as measured in the scows, and the price named shall include all expenses of transportation and disposal of dredged material as above provided.

The engineer officer in charge will indicate to the contractor during the progress of the work where and when wharfing or revetment is to be removed and dredging is to be done, and all work shall be executed in strict accordance with his instructions. Operations will be under the immediate supervision of inspectors appointed by the engineer officer in charge, and their instructions shall be observed by the contractor and his employés.

Material dredged outside of the designated lines of excavation, or deposited otherwise than as herein specified, will not be paid for.

To insure correct measurements, the material shall be properly leveled in the scows by the contractor or his agent whenever required by the inspector.

The contractor must be prepared to carry on the work as rapidly as may be considered desirable by the engineer officer in charge, provided funds are available for payment therefor, but he will not be required to remove by dredging more than 400,000 cubic yards of material during any one calendar month. Bidders shall state in their proposals the kind, capacity, number and condition of the dredges, scows, and other appliances which they propose to use. Should their offer be accepted, these statements will constitute a part of the contract, and any disadvantageous alteration in the working plant, made without the knowledge and consent of the engineer officer in charge will be considered a violation thereof. The plant shall be adapted to the work and shall be kept in good condition at all times.

As each separate appropriation by Congress becomes available the engineer officer in charge shall indicate to the contractor, in writing, the work to which it is to be applied, and assign a date for the completion thereof, subject to the condition expressed in the preceding paragraph. If the time allotted for such work is extended at the request of the contractor, for any cause whatever, all resulting expense to the United States incurred after the date thus assigned shall be deducted from payments due or to become due the contractor.

The contractor will not be permitted to take advantage of any error or omission in these specifications, as full instructions will always be given should error or omission occur.

The contractor will be required to discharge any agent or employé whose conduct is unsatisfactory to the engineer officer in charge.

Payments will be made monthly if the amount and character of the work is satisfactory, 10 per cent. being reserved until the total amount thus retained is equal to 10 per cent. of the cost of completing the entire contract as estimated by the engineer officer in charge. When this amount has been retained, no further reservations shall be made from the monthly payments; and at the last monthly payment of each fiscal year such portion of the total amount retained as will then reduce it to 10 per cent. of the cost of completing the entire contract, as estimated by the engineer officer in charge, shall be paid to the contractor. Should work be discontinued for a period of one year owing to lack of funds, the total amount reserved from previous payments shall be paid to the contractor.

Bidders shall state on the form hereto appended (1) a price per cubic yard for material excavated, and deposited at places provided by the contractor and approved by the engineer officer in charge; (2) a price per cubic yard for material excavated and deposited upon League Island; (3) a price per linear foot for the removal of the pile and timber revetment, and (4) the plant which they propose to employ in the work.

COMMENCEMENT OF THE WORK.

The amount of money now available for the work is about $390,000. The work will be commenced on or before April 1, 1891, and will proceed in the following order:

1. The piling at the lower end of Windmill Island, and the revetment along the east and west fronts of the island will be removed. The approximate length of this piling and revetment is 7,500 feet.
2. Windmill Island will be removed by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside of the island, except where a less depth may be required by the engineer officer in charge. The approximate amount of material to be removed is 700,000 cubic yards.
3. The revetment of the canal between the islands and the revetment inclosing Smith Island will be removed. The approximate length of this revetment is 2,500 feet.
4. Smith Island will be removed by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside the island, except where a less depth may be required by the Engineer Officer in charge. The approximate amount of material to be removed is 300,000 cubic yards.
5. The revetment of the cross channel north of Smith Island will be removed. The approximate length of this revetment is 1,000 feet.

6. The revetment along the north shore of Petty Island will be removed. The approximate length of this revetment is 7,000 feet.

7. The funds remaining after the work above described has been executed will be applied to dredging about 1,000,000 cubic yards of material from the north front of Petty Island, the cut to be outside of the existing dike and extend to a depth not exceeding 8 feet below mean low water.

The work above described and to be executed with funds now available shall be completed on or before June 30, 1892.

LETTER OF INSTRUCTIONS TO THE BOARD OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., November 25, 1890.

COLONEL: The accompanying papers are transmitted for the information of the Board of Engineers constituted by Special Orders, No. 80, Headquarters Corps of Engineers, November 24, 1890, to consider and report on the project and specifications submitted by Maj. C. W. Raymond, Corps of Engineers, for completing the improvement of Philadelphia Harbor, Pennsylvania, under the provisions of the river and harbor act of September 19, 1890.

Attention is invited to the letter and its inclosures from the Acting Secretary of the Navy with reference to the deposit of dredged material upon League Island. It is desired that the specifications should provide that bidders shall state (1) a price per cubic yard for material excavated and deposited at places provided by the contractor and approved by the engineer officer in charge; (2) a price per cubic yard for material excavated and deposited upon League Island.

By command of Brigadier General Casey:

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Col. WM. P. CRAIGHILL,
Corps of Engineers.

INCLOSURES TO LETTER OF INSTRUCTIONS TO THE BOARD OF ENGINEERS—CORRESPONDENCE WITH REFERENCE TO THE DEPOSIT OF DREDGED MATERIAL UPON LEAGUE ISLAND.

BUREAU OF YARDS AND DOCKS, NAVY DEPARTMENT,
Washington, D. C., September 11, 1890.

SIR: From a conversation with General Casey, Chief of Engineers, U. S. A., which I reported to you, it was understood by me that in asking the proposals for removing Smith and Windmill Islands, in the harbor of Philadelphia, an item would be inserted to the effect that bidders would be asked to bid upon depositing the earth upon League Island.

I stated in this conversation that I had been informed that it probably could be done as cheaply as to tow the scows with the mud the great distance required by regulations.

I respectfully invite your attention to the proposal and specifications for the removal of Smith and Windmill Islands, Philadelphia Harbor, the marked parts of which are those affecting League Island, and very different from my understanding as to what they were to be, and in my opinion of no practical service to the Navy Department.

The naval appropriation bill for the fiscal year 1890, per act March 2, 1889, contains the following item:

> Navy-yard, League Island, Pennsylvania, for dredging and filling in, seventy-five thousand dollars, and in the expenditure of this sum the Secretary of the Navy may coöperate with the Secretary of War and utilize any earth that may be recovered from adjacent waters under appropriations made by Congress.

It will be seen from the specifications that it is proposed to dump the earth removed from these islands in the vicinity of League Island in 6 feet of water.

The only way this earth could be utilized would be by again dredging it and depositing upon League Island.

Now, as we have so much dredging to do to deepen the Back Channel, it would appear as if it were better to do this and deposit it upon the island, and have the double result of a deep harbor and raised island at no greater cost.

Very respectfully,

N. H. FARQUHAR,
Chief of Bureau.

The SECRETARY OF THE NAVY.

[First indorsement.]

NAVY DEPARTMENT,
September 12, 1890.

Respectfully referred to the honorable the Secretary of War, whose attention is called to the matter.

B. F. TRACY,
Secretary of the Navy.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 13, 1890.

Respectfully referred to Major C. W. Raymond, Corps of Engineers, for remark.

To be returned.

H. M. ADAMS,
Major, Corps of Engineers, in charge.

[Third indorsement.]

U. S. ENGINEER OFFICE,
Philadelphia, Pa., September 15, 1890.

Respectfully returned to the Chief of Engineers, U. S. Army.

The recommendations made with reference to the deposit of material at League Island, in my report of July 16, 1890, were prepared after full consultation with the naval authorities at League Island, and were supposed to be in accordance with the wishes of the Navy Department.

The material can not be placed as cheaply on League Island as in other localities. At the present time I doubt whether it can be dumped outside and along the shore of League Island for a rate much, if any, less than it can be placed elsewhere. For future contracts there is every reason to believe that the cost of dumping the material along the shore of League Island will be much greater than the cost of its disposition elsewhere.

The specifications referred to were prepared in accordance with instructions contained in the letter of the Chief of Engineers, dated July 28, 1890.

It is probable that proposals for the continuance of this work under a new appropriation may be invited in the near future, in which case bids may be asked in accordance with the wishes of the Navy Department.

It will be a matter of satisfaction to me if the work of improvement of Philadelphia Harbor proves incidentally to be of benefit to the League Island navy-yard, but it is my opinion that the dumping of any considerable portion of the excavated material at that locality will result eventually in a decided increase in the cost of the work.

C. W. RAYMOND,
Major, Corps of Engineers.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 22, 1890.

Respectfully returned to the Secretary of War.

The specifications alluded to herein were made in accordance with a project and recommendations covering the balance of $200,000 approved by the Acting Secretary of War, July 24, 1890, by indorsement upon 4585, Engineer Department, 1890, herewith. In accordance with the project as recommended, the specifications stated that "dredged material in such quantities and at such times and places as the Engineer Officer in charge may direct shall be deposited at localities having a least depth of 6 feet at mean low water at or near League Island. All other dredged material shall be removed by the contractor to localities to be provided by him and subject to the approval of the Engineer Officer in charge," and the specifications required that bidders should name two prices, as follows: (1) "Per cubic yard for material deposited at places provided by the contractor and approved by the Engineer Officer in charge," and (2) "per cubic yard for material deposited at or near League Island, as hereinbefore provided." The recommendations as to the disposition of material at League Island, Major Raymond states in the preceding indorsement, were prepared after full consultation with the naval authorities at League Island, and were supposed to be in accordance with the wishes of the Navy Department.

This consultation of Major Raymond was subsequent to the interviews of Captain Farquhar with me and were believed to cover the final solution of the deposit of earth at League Island by the Navy Department. I have no recollection of promising to ask bidders to state the prices at which they would deposit earth *upon* League Island, but there are no objections to such inquiry in subsequent calls for bids.

Under the advertisement and specifications as made four bids were received, which with abstract are inclosed with Major Raymond's letter of transmittal, dated September 16, 1890, herewith. No change can now be made, and one of the bids must be accepted or all must be rejected accordingly. The new river and harbor act approved September 19, 1890, appropriates $200,000 additional for continuing the work, and provides that the Secretary of War may enter into contracts for the entire work, to be paid for as appropriations may from time to time be made by law.

Inasmuch as better prices may be anticipated when larger amounts of work are let, the bids now received will be rejected with the view of adding the balance of the old appropriation to the means made available by the new bill, and under the new specifications prices for depositing material on League Island can be solicited.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
September 24, 1890.

The views of the Chief of Engineers are concurred in.

By order of the Acting Secretary of War.

SAML. HODGKINS,
Acting Chief Clerk.

LETTER OF THE ACTING SECRETARY OF THE NAVY.

NAVY DEPARTMENT,
Washington, October 3, 1890.

SIR: Referring to your letter of the 24th ultimo, inclosing a statement of September 22 of the Chief of Engineers, U. S. Army, I have the honor to state that the Department learns with satisfaction that it will be practicable, under the new specifications which the Chief of Engineers proposes to issue, to solicit prices for depositing the material on League Island. The Bureau of Yards and Docks, in the Navy Department, attaches great importance to this form of statement in calling for bids, as the form previously used, namely, "localities at or near League Island," would fail entirely to answer the purpose of the act of March 2, 1889, providing that the Secretary of the Navy in coöperation with the Secretary of War may utilize any earth removed from adjacent waters.

Appended hereto are the additional items which this Department requests that the War Department will be pleased to embody in its specifications when bids are again solicited. For the further illustration of these items, I also transmit herewith a map of League Island.

I have the honor to be, sir, very respectfully,

J. R. SOLEY,
Acting Secretary of the Navy.

The SECRETARY OF WAR.

ITEMS.

Item 1.—Dredged material in such quantities and at such times as the engineer officer in charge may direct shall be deposited within the limits of the navy-yard, League Island, on the island proper, east of Broad street

The material so deposited may be landed at such points on the dikes east of Broad street and the filled portion of the yard as the contractor may select. First material will be landed and spread out over an area 600 feet wide, measured from the Delaware River dike, and beginning at the easterly limit of said fill and extending thence in an easterly direction along said dike; the filling to be sufficiently above the grade of the yard to allow for shrinkage; and the work of depositing and spreading to be under the supervision and inspection of the civil engineer of the navy-yard.

Item 2.—The contractor shall have the privilege of depositing material other than that designated for the island proper of the navy-yard in the back channel of said yard east of Broad street; provided it is placed and filled to such height not above grade, with proper allowance for shrinkage, as shall be directed by the civil engineer of the said navy-yard.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 7, 1890.

Respectfully referred to Maj. Charles W. Raymond, Corps of Engineers, for remark, and especially as to whether there would be any objection to the fill between the island and the mainland, and its probable effect upon the channels of the main river.

To be returned. .

By command of Brigadier-General Casey.

H. M. ADAMS,
Major, Corps of Engineers.

[Third indorsement.]

U. S. ENGINEER OFFICE,
Philadelphia, Pa., October 13, 1890.

Respectfelly returned to the Chief of Engineers, U. S. Army, with accompanying letter of this date.

C. W. RAYMOND,
Major, Corps of Engineers.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 13, 1890.

GENERAL: In compliance with instructions contained in your indorsement of October 7, 1890, I have the honor to submit the following remarks upon the letter of the Acting Secretary of the Navy to the Secretary of War, dated October 3, 1890, having reference to proposed work at League Island in connection with the improvement of Philadelphia Harbor. There is, in my opinion, no objection to the proposed fill between League Island and the mainland. The volume of tide-water passing in and out of this channel is too small, and the velocities are too feeble to have any appreciable influence upon the channels of the main river.

There are many places along the river, the value of which would be greatly enhanced by depositing the dredged material upon them. These places are private property, and there is good reason to believe that the cost of placing the material above low water would be defrayed by the owners, so that the contractor would only have to dump it in suitable basins, which can easily be provided. It is quite possible that the contractor may be able to make even more advantageous arrangements.

It is, however, necessary that suitable places above and below the work should be available for dumping, independent of arrangements with private parties; for experience shows that if the contractor is entirely dependent upon the private owners for dumping places, he will find it difficult, if not impossible, to obtain reasonable terms. Fortunately section 6 of the act of September 19, 1890, gives authority under which it is possible to provide suitable places above and below the work for the dumping of the dredged material.

It is desirable to have dumping places above and below the work, so that the scows can be taken to them with the tide at any time. The question of distance is of no practical importance, the difference in cost between towing to League Island and Mifflin Bar being very small (estimated at about 1 cent per yard), and vastly overbalanced by the greater convenience of the latter site.

It will appear from the above remarks that the most favorable condition under which the contract can be made is to leave the contractor perfectly free to dispose of all the excavated material to his own best advantage, providing him with convenient dumping places to use should he find it desirable. The imposition of any condition restricting the freedom of the contractor in this matter is sure to increase the cost of the work.

Item 1 of the specifications accompanying this letter not only requires the contractor to deposit at League Island material which it might be to his advantage to place elsewhere, but also compels him to land it above low water and rehandle it in such a way as to greatly increase the expense. He must provide a special plant for this purpose. To fill the area marked on the accompanying tracing "to be filled first" would, in my opinion, cost at the lowest estimate 15 cents per cubic yard more than it would cost to dump the material at Mifflin Bar or any other convenient locality. Thus the filling of this strip alone would increase the cost of the work more than $125,000, in addition to the increase due to restricting the contractor's freedom in the disposal of material. The filling of the space in rear of this strip would involve an additional cost of about 25 cents per cubic yard, making the total additional cost for this space about $1,140,000.

Item 2 gives the contractor, under certain expensive conditions, the privilege of depositing material in the back channel of League Island navy-yard. As the depth of this channel at low water is from 1 to 2 feet, and the dumping scows draw 7 feet, and as the low-water channel is too narrow to turn the scows in, the contractor could under no circumstances avail himself of this privilege.

The naval act of March 2, 1889, appropriates $75,000 for dredging and filling in at League Island, and provides that—

> In the expenditure of this sum the Secretary of the Navy may coöperate with the Secretary of War, and utilize any earth that may be removed from adjacent waters under appropriations made by Congress.

It appears to have been the intention of Congress that this sum should be applied to the payment of the additional cost of this method of disposing of the material. Since the establishment of a special plant is necessary, the sum is probably not sufficient to induce any contractor to do the work at the additional prices above estimated.

The river and harbor act of September 19, 1890, provides that the work of improving Philadelphia Harbor shall be executed "according to the plan reported by the Board of Engineers, and transmitted to Congress April 7, 1888, and printed as House Executive Document 260, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided*, That the cost of the improvement shall not be thereby increased." The Board of 1888 did not definitely determine places for the disposal of the dredged material, but indicated several possible locations, and among them League Island. The estimates of the Board, however, do not include the cost of placing any of the excavated material above low water, and the project can not be modified to include this work without increasing the estimated cost of the work about $1,265,000. This opinion is based upon experience in dredging and careful inquiry.

Finally I invite attention to the fact that the work contemplated under these proposed specifications is to be done under the supervision, inspection, and direction of a subordinate officer of another Department, who is not under the control of the engineer officer making the contract and the payments under it and responsible for the work, or even under the control of the War Department.

The letter of the Acting Secretary of the Navy, with its inclosure and accompanying tracing, is returned herewith.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 2, 1890.

Respectfully returned to the Secretary of War.

The Navy Department requests that certain items be embodied in the specifications for improving harbor at Philadelphia. Attention is invited to the inclosed report of October 13 from Maj. C. W. Raymond, to whom these papers were referred, and to the report of Board of Engineers, with accompanying specifications, for improvement of the harbor at Philadelphia, submitted to the Secretary of War to-day in another communication.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

LETTER OF THE ASSISTANT SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, D. C., December 4, 1890.

SIR: Referring to your letter of October 3 last, relating to the proposed work on League Island in connection with the improvement of the harbor of Philadelphia, and to the "items" which your Department desired to have embodied in the specifications for improvement, I have the honor to invite your attention to the inclosed copy of a report from the Board of Engineers, dated November 29 last, to whom the whole subject was referred.

The Department has approved of the proposed project as recommended by the Board for the improvement of the harbor, which contemplates the deposit of dredged material upon League Island in accordance with the wish of your Department, so far as is justifiable under the law, and it is suggested, should it be deemed necessary, that you direct the proper officer of the Navy Department to confer with Major Raymond at Philadelphia on the subject. This should be done, if at all, before the letting of the work is advertised.

The tracing of League Island which accompanied your letter is herewith returned.

Very respectfully,

L. A. GRANT,
Assistant Secretary of War.

The SECRETARY OF THE NAVY.

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 26, 1890.

Respectfully referred to Major Raymond, in order that he may explain to bidders where the Navy Department desires to have the earth deposited on League Island. Major Raymond will see that all bidders understand exactly what is wanted on the island, so that no mistake can be made.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

REPLY TO ABOVE SIXTH INDORSEMENT.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 2, 1891.

GENERAL: I have the honor to acknowlodge the receipt of letter of the Navy Department dated October 3, 1890, having reference to the deposit of dredged material from Philadelphia Harbor upon League Island, referred to me by your indorsement of December 26, 1890, which indorsement instructs me to explain to bidders where the Navy Department desires to have the earth deposited on League Island and to see that all bidders understand exactly what is wanted on the island, so that no mistake can be made.

In compliance with these instructions, I will endeavor to give the fullest information on this subject to all persons proposing to bid on this work; but the attention of the Department is respectfully invited to the fact that the specifications for the improvement of Philadelphia Harbor, sent to me for my information and guidance on December 5, 1890, under which I have advertised for proposals, do not give this office any control over the place of deposit of dredged material on League Island, except that such material shall be deposited "within the limits of the navy-yard, League Island, on the island proper, east of Broad street." The specifications as approved by the Chief of Engineers do not require the contractor to spread or grade the material, as desired by the Navy Department.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.
(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

SPECIFICATIONS DATED DECEMBER 12, 1890, AMENDED SO AS TO REQUIRE BIDDERS TO STATE AN ADDITIONAL PRICE PER CUBIC YARD FOR SPREADING MATERIAL UPON LEAGUE ISLAND.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 23, 1891.

MAJOR: I inclose an additional clause for the specifications for the improvement of Philadelphia Harbor, to be added to the last paragraph under the head "Conditions of the work," as indicated in copy herewith. You will please have this printed and distributed to all persons who have received the specifiations dated December 12, 1890, or who may ask for them hereafter.

The map referred to in the specifications, showing plan of the United States navy-yard, League Island, and also showing portion of yard to be filled with material from Smith and Windmill Islands, is inclosed.

By command of Brigadier-General Casey:

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Maj. C. W. RAYMOND,
Corps of Engineers.

THE ADDITIONAL CLAUSE.

Bidders shall state on the form hereto appended (1) a price per cubic yard for material excavated and deposited at places provided by the contractor and approved by the engineer officer in charge; (2) a price per cubic yard for material excavated and deposited upon League Island; (2½) a price per cubic yard for spreading said material upon League Island at such places as may be required by the Navy Department not outside of the limits shaded upon the map to be seen in this office; (3) a price per linear foot for the removal of the pile and timber revetment; and (4) the plant which they propose to employ in the work.

LETTER TRANSMITTING PROPOSALS OPENED FEBRUARY 12, 1891, AND RECOMMENDING AWARD OF CONTRACT.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., February 12, 1891.

GENERAL: I have the honor to transmit herewith an abstract of proposals, accompanied by one copy of each proposal received and opened by me this day, for dredging and removal of wharfing in the improvement of the harbor of Philadelphia.

The lowest bidder for the removal of material and revetments is the American Dredging Company of Philadelphia, Pa. This company is also the lowest bidder for depositing material upon League Island. Its bid of 18 cents per cubic yard for spreading material on League Island is, I am informed, the price to be paid for every cubic yard which is rehandled after being deposited on the island. The offers of the other bidders for spreading are, I am informed, the additional prices to be charged on every cubic yard deposited on League Island, whether it is rehandled or not.

It is impossible to estimate the cost of spreading at the price bid by the American Dredging Company until the quantity to be rehandled is known. This depends upon the methods employed. If a hydraulic method is permitted no rehandling will be required.

I respectfully recommend that the contract be awarded to the American Dredging Company of Philadelphia, Pa., this company being considered responsible and its bid reasonable and the most advantageous to the Government.

Attention is invited to the fact that the City Trust, Safe Deposit and Surety Company of Philadelphia appears by its president, Mr. Chas. M. Swain, as one of the guarantors of the Penn Dredging Company, and the same gentleman appears as the second guarantor in his individual capacity.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTER RECOMMENDING RECONSIDERATION OF THE PROJECT FOR IMPROVEMENT OF PHILADELPHIA HARBOR WITH REFERENCE TO THE REQUIREMENTS OF THE SUNDRY CIVIL ACT APPROVED MARCH 3, 1891.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., March 5, 1891.

GENERAL: I have the honor to invite your attention to recent legislation in the sundry civil act, just passed by Congress, which imposes new and important conditions upon the problem of the improvement of Philadelphia Harbor. The provisions referred to are as follows:

> For improving harbor at Philadelphia, Pa.: Continuing improvement, removal of Smith Island and Windmill Island, Pennsylvania, and Petty Island, New Jersey, and adjacent shoals, $300,000: *Provided,* That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may consider desirable, and the material to be removed from said islands and shoals under this appropriation, and appropriations heretofore made, shall be deposited and spread on League Island, and to the extent of the cost of such deposit and spreading the said appropriations are hereby made available: *Provided, further,* That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter.

In view of these provisions it appears to be impossible to make a contract for the improvement of Philadelphia Harbor in accordance with the specifications upon which proposals were received and opened at this office on February 12, 1891, for the following reasons:

1. The specifications provide for the removal of about 17,000,000 cubic yards of material. Should the line of excavation on Petty Island be changed as authorized in the act, the amount of material to be removed will be increased by about 1,000,000 cubic yards.

2. The specifications further provide that a certain part of the heavy material removed shall be deposited in the prolongation of Fishers Point Dike. It was further the intention to permit the deposit of heavy material, wherever found, in those parts of the channel where there are excessive depths. These are regarded as very important parts of the project. Under existing law they cannot be carried out, since all material removed is required to be deposited at League Island.

3. The specifications further provide that the rate of progress of the work of excavation is to be determined by the rate of advance of actual wharf constructions to the new harbor lines, so as to maintain the assigned section of the new channel. The project for the commencement of the improvement submitted by me on July 16, 1890, recommended the removal of Smith and Windmill Islands to a depth of 8 feet below mean low water, and this work is provided for in the specifications. The advisability of doing this work was discussed in the project referred to, with the following conclusions:

> If this is done, the action of natural forces may be expected to largely diminish the volume of the lower end of the southern shoal. I am informed that as soon as the harbor lines are definitely located a large part of the Camden water front will be bulkheaded along the advanced line, and the extension of the wharves on the Philadelphia shore may be expected to commence at the northern end of the new line. It is probable that these changes, in connection with the eastward direction of the ebb currents, will be of sufficient extent to hold in check any tendency toward the reformation of the islands above the 8-foot curve.

At the time this project was prepared the great difficulty was to find convenient places for the disposal of the dredged material. No obstacle was known to supplying, without expense to the United States, all material needed for the filling behind the Camden bulkheads. The law now prohibits the supply of this material for this purpose, and under these circumstances it is feared that the Camden water front will not be advanced.

With reference to this subject, the Board of Engineers of 1888, in their report of March 30, 1888, containing the project adopted by Congress, remarked as follows:

> The removal of Smith and Windmill Islands should not begin or be carried on without the simultaneous regulation of the port warden's lines of both shores of the river so as to maintain the assigned section of the new channel, as a failure in this respect would only be followed by the reformation of these islands in whole or in part by the river. Moreover, it is not sufficient that these lines should simply be laid down on paper, but their existence as actual constructions should be a part of the progressive scheme for the proper improvement of this portion of the river.

4. The specifications further provide for the execution of a definite amount of work with the funds now available. It will be necessary to readjust the amount of work to be done in conformity with the increased cost imposed by the new conditions.

Under these conditions I do not consider it advisable to commence the work of improvement under the project provided for in the specifications. If it is so commenced, serious injury to the channels may result.

For the reasons above stated, I feel it my duty to suggest the advisability of reconsidering the whole project for the improvement of Philadelphia Harbor with reference to these new conditions before the award of any contract for the commencement of the work. It is believed that a project for the execution of the work in harmony with this new legislation can be devised.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOS. L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

AUTHORITY FOR REJECTION OF THE BIDS OPENED FEBRUARY 12, 1891.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 18, 1891.

MAJOR: Referring to your telegram of this date, the following copies of indorsements on your letter of February 12, 1891, are sent you for your information:

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 9, 1891.

Respectfully submitted to the Secretary of War. Of the three bids inclosed, two of them, viz, that of the Penn Dredging Company and that of the National Dredging Company, named the same prices, $14\frac{9}{10}$ cents per cubic yard for dredging and \$2.97½ and \$3.25 respectively per linear foot for the removal of pile and timber wharfing or revetment. These prices are too high for that work. The third bid, that of the American Dredging Company, the lowest for excavating and removing material, for removal of pile and timber wharfing or revetment, and for excavation and removal of material inclusive of its deposit on League Island, names 18 cents per cubic yard for spreading. This price for spreading is too high. The sundry civil bill, approved March 3, 1891, enacts as follow: * * * "\$300,000: *Provided*, That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may consider desirable, and the material to be removed from said island and shoals under this appropriation and appropriations heretofore made shall be deposited and spread on League Island, and to the extent of the cost of such deposit and spreading the said appropriations are made available: *Provided, further,* That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter."

This enactment introduces and establishes conditions not existing when the proposals were opened and the specifications under which the proposals were made are not applicable in all respects to the new conditions. Regarding the case as a whole it is recommended that all the bids be rejected and that the work be readvertised under specifications so modified from the old ones as to conform to the legislation in the sundry civil act of March 3, 1891.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *March 10, 1891.*

Approved as recommended by the Chief of Engineers.

L. A. GRANT,
Acting Secretary of War.

By command of Brigadier-General Casey:
Very respectfully, your obedient servant,

THOS. TURTLE,
Captain, Corps of Engineers.

Maj. C. W. RAYMOND,
Corps of Engineers.

REVISED PROJECT FOR COMPLETION OF THE WORK OF IMPROVING THE HARBOR OF PHILADELPHIA, INCLUDING PROJECT FOR APPLICATION OF AVAILABLE FUNDS IN ACCORDANCE WITH THE PROVISIONS OF THE SUNDRY CIVIL ACT OF MARCH 3, 1891.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., March 14, 1891.

GENERAL: In compliance with instructions contained in Department telegram dated March 6, 1891, I have the honor to submit the following revised project for the completion of the work of improving the harbor at Philadelphia, Pa., including a project for the application of the funds now available, prepared in accordance with the provisions of the sundry civil act approved March 3, 1891.

The provisions of the sundry civil act of March 3, 1891, above referred to, are as follows:

> For improving harbor at Philadelphia, Pa.: Continuing improvement; removal of Smith Island and Windmill Island, Pennsylvania, and Petty Island, New Jersey, and adjacent shoals, $300,000: *Provided,* That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may conside rdesirable, and the material to be removed from said islands and shoals under this appropriation and appropriations heretofore made shall be deposited and spread on League Island and to the extent of the cost of such deposit and spreading the said appropriations are hereby made available: *Provided further,* That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter.

The existing project for the completion of this work, which was submitted to the Department on November 20, 1890, and approved December 4, 1890, was prepared in accordance with the provisions of the river and harbor act of September 19, 1890, which requires the work to be executed according to the plan reported by the Board of Engineers and transmitted to Congress, April 7, 1888, subject to such modifications by the Secretary of War as do not increase the cost of the improvement. This project is given in detail in the approved specifications under which proposals were received and opened at this office on February 12, 1891. The report of the Board of Engineers of 1888 is printed in the Annual Report of the Chief of Engineers for 1888, Part I, page 679.

In the Delaware River, between Kaighn Point and Fishers Point, the main flood and ebb currents move in different paths. The flood follows the New Jersey shore and, passing to the westward of Petty Island, turns to the eastward into the Pennsylvania Channel; the ebb, before the construction of Fishers Point Dike, followed the New Jersey shore south of Petty Island, and crossing at the same place as the flood, turned to the westward into the channel west of Smith and Windmill Islands. The scheme of rectification recommended by the Board contemplates the creation of a single channel, in which the directions of the flood and ebb currents shall as nearly as possible coincide with dimensions adjusted to the physical conditions of the water way.

The Board established the width of the projected channel at about 2,000 feet, its cross-section at about 55,000 square feet at mean tide, and its depth over a distance of about half the width at 26 feet below mean low water. In determining these dimensions it is believed that the Board was guided by a study of the dimensions of the water way between Kaighn Point and Gloucester Point, which have remained practically without change for many years, and therefore may be regarded as well adapted to a permanent regimen in this vicinity.

The Board proposes to obtain these dimensions by removing Smith and Windmill Islands and the adjacent shoals, by advancing the wharves on the Philadelphia and Camden water fronts to the established limits of the new channel, by cutting off a portion of the north shore of Petty Island, and by the ultimate closure of the channel south of Petty Island by the extension of Fishers Point Dike. These are all essential parts of the scheme of rectification; and the actual reconstruction of the Philadelphia and Camden water fronts upon the new lines was considered of special importance. With reference thereto the Board remarks as follows:

> The removal of Smith and Windmill Islands should not begin or be carried on without the simultaneous regulation of the port warden's lines of both shores of the river, so as to maintain the assigned section of the new channel, as a failure in this respect would only be followed by the reformation of these islands in whole or in part by the river. Moreover, it is not sufficient that these lines should simply be laid down on paper, but their existence as actual constructions should be a part of the progressive scheme for the proper improvement of this part of the river.

It was not a part of the duty of the Board of Engineers of 1888 to prepare specific and detailed directions for the systematic execution of the work. Indeed, this would have been impossible with the information then available. The advisory commission, to the harbor commissioners of Philadelphia, in their report of December 16, 1887, expressed the opinion that the projected improvement could be made "without injury to the harbor by the skillful execution of a properly prepared project;" but they did not give their views regarding the methods and order of execution which should be followed. Nevertheless, the principles and methods to be adopted in the actual execution of the work constitute by far the most difficult and delicate part of the problem. If the complete rectification of the river could be effected at once, all its parts being simultaneously established, there would be little difficulty to anticipate, but the progressive development of the new conditions by operations extending over a long period requires the most careful adjustment of the work so as to avoid unnecessary expense and serious injury to the channels.

The method of improvement recommended for adoption, and the considerations upon which it is based, are set forth in my project for the application of the appropriations of August 11, 1888, and March 2, 1889, which was submitted to the Department on July 16, 1890, and approved

July 24, 1890. This method, however, was intended to apply to the commencement of the work only, and no attempt was made to establish a plan to be followed in future operations. Since the preparation of that project the present condition of the channels has been determined by a detailed survey, completed in September, 1890, and I have investigated the changes therein by comparisons with the surveys of 1819, 1843, and 1878, to facilitate the labors of the Board of Engineers for the establishment of harbor lines in the port of Philadelphia. In the light of the information thus gained, I now feel justified in submitting the following plan of procedure for the consideration of the Department.

In the establishment of the assumed normal dimensions of the rectified river, the plan of the Board of Engineers of 1888 contemplates operations some of which are of a progressive and some of a conservative character. The progressive operations consist in the gradual removal of the islands and shoals between Philadelphia and Camden, west of Petty Island; the conservative operations are the widening of the channel north of Petty Island, the extension of the Fishers Point Dike, and the advance of the piers and bulkheads on the Philadelphia and Camden water fronts to the new harbor lines. The operations of removing the islands and shoals are termed *progressive* because they are the fundamental operations upon which the character and extent of all the others are based, and thus determine the progress of the work. The other operations are termed *conservative* because, when considered with reference to the physical problem of river rectification, their only object is the maintenance of the new depths gradually created elsewhere.

If any part of the islands and shoals below the water level is removed, the result will be an increase in the dimensions of the channel volume beyond their normal values. The new depths can only be permanently maintained by one or more of the following conservative operations:

1. By advancing the piers and bulkheads on one or both water fronts so as to compensate in a greater or less degree for the change in the channel dimensions.
2. By widening the channel north of Petty Island so as to bring together the paths of the tidal currents and concentrate the action of the latter upon the excavated spaces.
3. By closing or partly closing the gap at Fishers Point Dike so as to compel the tidal waters now flowing through the channel south of Petty Island to flow through the north channel, and thus increase the effect of widening the latter.

The general plan proposed is, therefore, to remove in succession limited portions of the islands and shoals, following each removal by a compensation obtained through one or more of the conservative operations above mentioned, the amount and character of these operations to be determined by observations during the progress of the work.

It may appear desirable that the progressive operation and the conservative operation intended to compensate for it should be executed simultaneously; but this would interfere with the proper study of the action of the tidal forces, and is unnecessary, as will appear from the following considerations, which are based upon the physical history of the river.

A comparison of cross-sections constructed from the four available surveys at eleven different positions between Kaighn Point and the foot of Petty Island, shows that very considerable changes in the width of water way may be made, under the conditions existing up to the present time, without producing any important change in the cross-sectional area of the low-water channel during a long interval. The low-water channel, instead of the mid-depth channel, is selected for investigation, since the former is the only channel which is free to change under the action of the tidal forces. Thus the mean width of water way between the foot of Petty Island and the head of Smith Island was reduced from 3,170 feet in 1843 to 2,420 feet in 1890, but the mean low-water cross-sectional area remained practically constant at about 49,500 square feet. Between the head of Smith Island and the foot of Windmill Island the mean width changed in the same interval from 2,880 feet to 2,130 feet, the mean cross-sectional area remaining constant at 50,000 square feet. Between the foot of Windmill Island and Kaighn Point the mean width changed, in the same interval, from 3,070 feet to 2,320 feet, the mean cross-sectional area remaining constant at about 54,500 square feet. The mean width of the whole reach, from Petty Island to Kaighn Point, changed in the same interval from 3,070 feet to 2,320 feet, the mean cross-sectional area remaining constant at about 50,650 square feet.

It follows from the above that although the mean width of water way has been thus greatly reduced, the volume of the low-water channel between the extreme points of comparison remains practically unchanged, being about 555,000,000 cubic feet in both 1843 and 1890. There have been, however, considerable changes in the form of the channel, and in the local channel volumes at different levels, some of which are discussed in my report of July 16, 1890; but this constancy of volume seems to indicate that these changes are principally due to a shifting of the material within the reach, and not to any great extent to the deposit of suspended material brought in from beyond its limits. In the vicinity of Philadelphia the ebb current travels from 1½ to 3 miles further than the flood, and thus there is a tendency to carry all suspended material down towards the sea.

But although the principal material for the formation of shoals during the progress of the work will probably be supplied from places within the limits of the improvement, it by no means should be inferred that therefore the progressive operations can be safely conducted without being soon followed by a proper compensation. It might appear admissible to allow the material to shift to any position in the water-way, since it will cost no more to dredge it from one place than from another. But the relations between the tidal currents are now very complicated, and the changes in those relations which must occur in the progress of the work will determine new directions and intensities in the resultant tidal forces, which may remove material outside the limits of the projected channel, or cause great temporary inconvenience by the deposit of material in the channels now in use. Material which is light enough to be taken up in suspension under the action of an increased velocity, such as the mud covering Smith Island Bar, will be carried out of the reach or else deposited in the shoal parts of the water way. Heavier material, such as composes the main body of the shoals, will be moved along the bottom, following the directions of highest velocity, and thus will eventually find its way into the deep parts along the thalweg. The successive removal of limited portions of the islands and shoals, each removal being followed by a suitable conservative operation, is the only method of execution permitted by the conditions established by the Board of 1888.

It is proposed to carry on the work of excavation by removing the islands and shoals in horizontal layers, since the power of the river to maintain channel volumes in the normal water way increases directly as the square root of the height of the plane of excavation above the thalweg. The excavation is to be commenced at the lower end of Windmill Island and proceed upstream, since there is a well-marked tendency in the shoals of the Delaware River to diminish at their lower and increase at their upper ends. Moreover, Smith Island and the revetments of the cross channel above it act as a support for the lower end of Smith Island Shoal, and they should not be removed until the movements of the latter have been provided for. This horizonal excavation, followed by the conservative operations required, will be continued until the new channel dimensions are fully established.

With reference to the conservative operations, it is to be remarked that the rate of extension of the piers and bulkheads on the Philadelphia and Camden water fronts is not under the control of the United States. No constructions can be extended to the new harbor lines until the port wardens' lines have been advanced thereto by the proper local or State authorities. Fortunately the lines have been thus advanced on the Camden front, and it is understood that the new piers and bulkheads will be constructed immediately, if filling can be obtained from the material excavated in the harbor. The practical reconstruction of the Philadelphia water front is a more difficult problem, requiring the preparation of a systematic and comprehensive plan and the action of the State legislature. It is now receiving earnest and intelligent study from the harbor commissioners of Philadelphia and other gentlemen representing the leading commercial interests of the city. The scheme of reconstruction can only be carried out by using material excavated during the progress of the improvement for widening Delaware avenue behind the new bulkheads. The Camden line being on the convex side of the river, its advance, considered as a conservative operation, is far more important and more immediately necessary than that of the Philadelphia line, for it will be made upon the shoal side of the channel, where deposits are most likely to occur. In my report of July 16, 1890, I have pointed out the fact that the observed effect of wharf advance from the Camden shore has been much more general across the whole water way than that of the advance from the Philadelphia shore, and the influence of the former in reducing the volumes of the shoals has been much greater than that of the latter.

The rate of progress of the other conservative operations is under the direct control of the General Government.

The widening of the channel north of Petty Island will modify the tidal conditions not only by increasing the amount of tide-water flowing through the Pennsylvania channel, but also by changing the direction of the resultant tidal action.

Some idea of the effect of the modification first mentioned can be formed by the observed influence of the Fishers Point Dike, which is considered elsewhere. The effect of the modification last mentioned can only be definitely ascertained during the progress of the work. It is proposed to execute the widening by cutting away the north shore of the island in successive vertical sections, the rate of progress to be determined by the conditions of the progressive operations in the river below.

The extension of the Fishers Point Dike so as ultimately to close the channel south of Petty Island can not fail to produce beneficial results since it will terminate the conflict of tidal currents which now occurs just below the island; but the work must be done gradually, since the dike produces marked changes in Smith Island Shoal which, if allowed to proceed too rapidly, might complicate the conditions below. Between

1883 and 1890 the shoal moved to the eastward and lost materially in volume under its influence. The dike is founded upon an embankment of hard material obtained by dredging in the channel north of Petty Island, and this method of construction has proved very satisfactory and has resulted in a large reduction in the cost of the work. It is proposed to deposit suitable material obtained during the progress of the excavation (such as the stone filling behind the revetments of the islands and in the dikes of the cross channel) along the extension of the dike, so as to gradually reduce the tidal flow and at the same time prepare a stable foundation for the future superstructure.

There is one other conservative operation which I consider very desirable, although it was not contemplated by the Board of 1888, and relates to the final establishment of a permanent regimen rather than to the progress of the work; that is, the partial rectification of the bottom of the channel by filling in excessive depths along the present thalweg with heavy material obtained in the excavation. Should the work of rectification be completed in accordance with the plan of the Board of 1888, there will be a false thalweg along the Philadelphia shore, over which the depths will be excessive, except where they may have been reduced by the movement of material in the river or by filling in for the construction of wharves. Every such excessive depth is a source of injury, since it induces an increase in the local tidal velocities and thus disturbs the uniformity of flow. It is not probable that sufficient heavy material will be found to fill the spaces below the theoretical bottom; but the new piers to be built on the Philadelphia shore will extend nearly across the present thalweg, and if heavy material is deposited along the lines they are to occupy their construction will be greatly facilitated. The shoaling, which is inevitable between the piers, will soon fill up the intervening spaces. The material obtained from the channel north of Petty Island is admirably adapted for such foundations, as is shown by our experience at Fishers Point Dike.

The project for the progressive execution of the work of improvement as above recommended requires the establishment of the following rules for the disposal of the dredged material:

1. A sufficient quantity of the heavy material first removed should be deposited along the extension of the Fishers Point Dike to gradually check the tidal flow through the channel south of Petty Island and form a foundation for the future completion of the work. This will require about 30,000 cubic yards.

2. All other heavy material wherever found during the progress of the work should be deposited in the channel at places where the depths are excessive. To completely fill the channel up to the theoretical bottom of the rectified river would require about 3,000,000 cubic yards of material and about half as much would be necessary to raise the level of the bottom along the axes of the new wharves. It is not probable that any such amount of heavy material will be obtained, but all that is available should be used for this purpose. Very little of such material will be obtained during the early stages of the work.

3. Ordinary dredged material should be supplied as rapidly as it is required for filling in behind the new bulkheads on the Camden and Philadelphia water fronts. These extensions have a local character with which the General Government is not concerned, but their vital connection with the work of river improvement and their influence upon its rate of progress require that they should have precedence before all other places in the receipt of material. The Camden front will require about 1,500,000 cubic yards, some of which is needed immediately.

The Philadelphia front will require about 500,000 cubic yards, none of which will be needed during the present year.

4. Material not needed for the purposes above mentioned should be deposited and spread on League Island until the island is raised to the established grade. It is highly desirable and greatly to the advantage of the Government to utilize this material for this purpose; but since this filling bears no physical relation to the work of rectification it should always be deferred until the needs of the improvement are satisfied. The total amount of material required at League Island will not exceed 7,500,000 cubic yards.

If all the material which can possibly be needed for the purposes above mentioned is supplied, we have provided for the disposal of less than 13,000,000 cubic yards, leaving about 5,000,000 cubic yards to be deposited behind the Mifflin Bar Dike or in other localities. There is more than enough material for all possible demands, and all public wants can be safely satisfied if it is permitted to do the work at the proper times and in the proper order.

The project for the completion of the work and the specifications based thereon, which were approved December 4, 1890, were prepared in accordance with the views above expressed, but it was not considered either necessary or desirable to provide in the specifications for all the work required. There is so much material to be removed, and it is so much to the advantage of the contractor to deposit it in the vicinity of the excavation, that it was thought best not to introduce any conditions regulating the deposit of material on the water fronts and in the channel. A simple permission to deposit was considered sufficient.

Under the provisions of the sundry civil act of March 3, 1891, it is impossible to apply the funds now available to the work of improvement, in accordance with the plan above recommended; but the following project for the application of these funds conforms to that plan so far as the law permits.

The adopted project, approved December 4, 1890, provides for the application of $390,000 to the successive removal of Windmill and Smith Islands to a depth of 8 feet below mean low water, and to the excavation of a part of Petty Island. With the sum of $690,000 now available, all the work thus projected could probably be done, even at the increased cost due to the requirement that the material shall be deposited on League Island. It is not desirable, however, to so far advance the improvement before a resonable compensation is obtained by the extension of wharves on the Camden water front. The considerations justifying the work proposed are given in full in my report of July 16, 1890, and the advance of the Camden water front is one of the necessary conditions thereof.

In my opinion it will be safe to excavate Windmill Island to a depth of 8 feet below low water. The section below the island near the termination of the 8-foot curve has about the same form and almost exactly the same area as the section across the upper end of Windmill Island would have after the completion of the proposed excavation, as shown on the appended sketch.* This is simply a transfer of the conditions now existing at the foot of Windmill Island to the foot of Smith Island, and the distance is so short that the tidal conditions are practically the same.

The continuation of the work by the removal of the upper part of Smith Island is evidently undesirable until the Camden wharves are advanced. It would release a mass of material from Smith Island Bar before provision has been made to carry it across the excavated spaces. It will probably be necessary to postpone the removal of any part of Smith Island until material is obtained which can be utilized in accordance with the necessities of the improvement.

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* Omitted. See general sketch.

It is accordingly recommended that so much of the funds now available as is necessary for the purpose be applied as follows:

1. To the removal of the piling at the lower end of Windmill Island and the revetments along its east and west fronts.
2. To the removal of Windmill Island by dredging to a depth of 8 feet below mean low water, the excavation extending to the natural contour of 8-foot depth outside the island, except where a less depth may be required by the Engineer officer in charge.
3. To the removal of the revetment on the south side of the canal between Windmill and Smith Islands.

It is proposed to do the work above described under specifications prepared in accordance with the instructions of the Chief of Engineers and submitted to the Department on this date. The work is estimated to cost $200,000.

Should the above recommendation receive approval there will remain an unallotted balance of $490,000. The application of these funds so as to conform as closely as possible to the plan of improvement can best be determined during the progress of the work. It is therefore recommended that this balance be held subject to the submission of a future project.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, division engineer, southeast division.)

APPROVAL OF PROJECT OF MARCH 14, 1891.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 19, 1891.

MAJOR: Your communication of March 14, 1891, is received, and your final recommendations, marked 1, 2, and 3, are approved, provided they do not interfere with or change the project of the Board of Engineers for the improvement of Philadelphia Harbor as required by law, or do not interfere with or change the work required by the act of March 3, 1891, making appropriations for the sundry civil expenses of the Government.

You will also submit prior to the completion of the work under these recommendations, Nos. 1, 2, and 3, another project for going on with the work of improving Philadelphia Harbor, so there shall be no delay, cessation, or intermission in the progress of this important improvement.

By command of Brigadier-General Casey:

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Maj. C. W. RAYMOND,
Corps of Engineers.

AN ACT empowering councils in cities of the first class to revise and establish the line for wharves and piers and low-water mark or bulkhead lines on the Delaware River in front of cities of the first class.

SECTION 1. *Be it enacted by the senate and house of representatives of the Commonwealth of Pennsylvania in general assembly met, and it is hereby enacted by the authority of the same,* That the select and common councils of cities of the first class be, and they are hereby, authorized from time to time to revise and establish the line beyond which no wharf or pier shall extend, and also to revise and establish the arbitrary low-water line or bulkhead line, on the Delaware River in front of cities of the first class in conformity with those now established by the Secretary of War or as they may from time to time be established by him during the progress of the work of the improvement of the harbors of said cities.

Approved the 8th day of June, A. D. 1891.

ROBT E. PATTISON.

G 3.

IMPROVEMENT OF SCHUYLKILL RIVER, PENNSYLVANIA.

The river and harbor act of September 19, 1890, appropriated $45,000 for continuing the improvement of the Schuylkill River.

The river between its mouth and Gibson Point, in its unimproved condition, carried a channel over the bar directly at its mouth with a depth of about 10 feet at mean low water, and between the bar and Gibson Point a ruling depth of about 16 feet.

The present project proposes the formation of a channel 400 feet wide and 24 feet deep at mean low water from the mouth of the river to Girard Point, a distance of about 1 mile; from thence to Gibson Point, a farther distance of about 3 miles, a channel 20 feet deep and 250 feet wide, except at the abrupt bend at Yankee Point, where the channel width was to be increased to 300 feet; from thence to Chestnut Street Bridge, Philadelphia, a distance of about 3 miles, a channel of navigable width and 18 feet deep at mean low water. This latter reach of river has required no other improvement than the removal of about 1,000 cubic yards of rock near Locust and South streets. The channels proposed are to be obtained by dredging at an estimated cost of $485,000, of which amount $438,750 has been appropriated.

During the past fiscal year under a contract with Frank C. Somers, dated March 4, 1891, 95,890 cubic yards of material were removed in widening to 300 feet the 20-foot low water channel at Yankee Point, and to 250 feet the channel directly above Penrose Ferry Bridge. In this work 30,340 cubic yards were removed from the former and 65,550 cubic yards from the latter locality.

The improvement of the channel of the Schuykill River by dredging was commenced in 1870, and up to the close of the past fiscal year about 1,416,000 cubic yards of material have been removed, of which about 550,000 cubic yards have been dredged in the formation of the channel near the mouth between deep water in the Delaware River and Girard Point, a distance of about 1 mile. The remaining 866,000 cubic yards have been removed from between Girard Point and Gibson Point, a distance of about 3 miles.

This work has resulted in the formation of a channel about 150 feet wide and 19 feet deep at mean low water across the bar at the river's mouth; a channel 250 feet wide and from 20 to 24 feet deep from inside the bar to Penrose Ferry Bridge; from thence to Point Breeze a channel 250 feet wide and 20 feet deep; and from Point Breeze to Gibson Point, a channel from 100 to 200 feet wide and 18 to 20 feet deep. Between Gibson Point and deep water inside the bar at the mouth the improved channel has maintained the depth to which it was dredged.

The channel over the bar, although twice dredged to a depth of 24 feet at mean low water by the removal of about 550,000 cubic yards of material, has quickly shoaled to 20 feet; to redredge this channel to the dimensions proposed in the project, viz, 400 feet wide and 24 feet deep, would require the removal of at least 350,000 cubic yards of material.

The shoaling principally occurs over a portion of the channel about 1,500 feet in length, and situated directly at the river's mouth. It is mainly due to the abruft angle at which the tidal currents of the Schuylkill meet those of the Delaware River, and the abnormal width of the Schuylkill at this point. From the experience of the past it seems highly probable that, instead of attempting to maintain the desired depth of 24 feet in this part of the river by dredging, it would be more assuredly and economically accomplished by the aid of dikes so placed as to produce tidal concentration upon the shoal area.

During the present season it is proposed to investigate, through the aid of current and tidal observations, the causes which now operate to form this bar, and to prepare a project for the application of available funds, about $20,000, towards the permanent improvement of this locality to a depth of 24 feet at mean low water.

The present demands of commerce limit the requirement of an improved river channel to that part of the river lying between the mouth and Gibson Point, or the lower 4 miles of the river. At Girard Point are located large grain elevators and wharves. At Gibson Point and Point Breeze, which are near each other and closely related as to commercial requirements, are the large storage tanks and wharves of the petroleum oil refineries. The interests assembled at these three points cover mainly the commerce of the Schuykill River, and both the grain and oil trade require deep-draft vessels for the proper and economical transaction of their business. Channel depths should exist which will permit the passage of vessels drawing 24 feet of water at all stages of the tide between the mouth of the river and Gibson Point.

The dredged channels which have been formed elsewhere than at the mouth have been permanent and if by regulating works at the mouth a 24-foot channel can be maintained it is believed that a permanent channel of equal depth can be formed by dredging in the reach of river between the mouth and Gibson Point. Until such a channel is formed, deep-draft vessels can only be moved at high water, unless they lighter a part of their cargoes over the outer bar.

This work lies in the collection district of Philadelphia, at which, as a port of entry, there was collected during the year ending December 31, 1890, revenue to the amount of $27,572,351.53. The nearest fort and light-houses are, respectively, Fort Mifflin and Schuylkill River range lights.

Total appropriations to June 30, 1891	$438, 750. 00
Total expenditures to June 30, 1891	413, 732. 71

Money statement.

July 1, 1890, balance unexpended	$222. 35
Amount appropriated by act approved September 19, 1890	45, 000. 00
	45, 222. 35
June 30, 1891, amount expended during fiscal year	20, 205. 06
July 1, 1891, balance unexpended	25, 017. 29
Amount (estimated) required for completion of existing project	46, 250. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	46, 250. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Schuylkill River, Pennsylvania, opened February 23, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed, 100,000 cubic yards.	Amount.
		Per cu. yd.	
1	Frank C. Somers, Camden, N. J.	0.18\frac{9}{10}$	$18,900
2	The Penn Dredging Co., Philadelphia, Pa	.19$\frac{7}{10}$	19,700
3	American Dredging Co., Philadelphia, Pa	.21	21,000
4	Atlas Dredging Co., Wilmington, Del	.20	20,000

Any necessary dredging of compact gravel, clay, or bowlders, such hard material to be paid for at one and one-half times the price bid for ordinary material.

Contract (dated March 4, 1891) entered into with Frank C. Somers.

COMMERCIAL STATISTICS.

The following statements of the foreign and domestic commerce of the Schuylkill River for the year ending December 31, 1890, have been compiled from the returns made to this office by shippers and consigners:

Freight movement.

Articles arriving.	Gross tons.	Value.
Ice	190,115	$1,034,472
Lumber	19,492	168,544
Marble, Italian	2,760	95,000
Wood	33,743	156,296
Stone, building	49,204	458,068
Stone, paving	40,064	215,778
Sand	53,037	32,449
Iron ore	77,000	231,000
Coal	71,134	248,960
Miscellaneous	34,633	1,038,990
Total	571,182	3,679,566

Articles departing.	Gross tons.	Value.
Grain	289,000	$5,393,000
Manure	25,359	40,378
Petroleum oil and products	582,616	9,554,320
Miscellaneous	9,000	270,000
Total	905,975	15,257,698

Vessel movement.

Class.	No. arriving, loaded.	No. departing, loaded.
Steamers	2	111
Sailing vessels	680	613
Canal-boats and barges	911	175
Total	1,593	899

G 4.

IMPROVEMENT OF ICE-HARBOR AT MARCUS HOOK, PENNSYLVANIA.

The harbor of Marcus Hook is situated on the right bank of the Delaware River, about 20 miles below Philadelphia. Its construction and maintenance as an ice-harbor was undertaken by the General Government in 1866.

The river and harbor act of September 19, 1890, appropriated $5,000 for this work; these funds have been held for the contingency of repairs and dredging, neither of which have been required during the last fiscal year.

The work accomplished in 1889 practically carried the project for the improvement of this harbor to completion. The harbor in its present condition consists of an area of 10 acres, with a depth of from 18 to 25 feet at mean low water over about 7½ acres, and from 18 to 12 feet over the remaining 2½ acres. Within this area are 7 detached ice-piers, consisting of stone superstructures upon timber crib substructures; two landing or shore piers of timber with crib substructures upon pile foundations, and 3 groups of mooring piles placed between the detached ice piers.

The 4 upper ice-piers were completed in 1871, and during the 20 years which have elapsed the wear of the ice upon the upper surfaces of the timber substructure, which is but slightly below the plane of mean low water, will necessitate, in the near future, repairs to this worn part of the substructure.

It is also probable that dredging will have to be resorted to at intervals to maintain the requisite depth of the water in the harbor.

For these objects funds should be available.

This work is located in the collection district of Philadelphia. This is the nearest port of entry, the collections during the year ending December 31, 1890, amounting to $27,572,351.53. The nearest fort and light-house are, respectively, Fort Mifflin and Christiana Light.

Total appropriations from 1866 to June 30, 1891	$214,000.00
Total expenditures from 1886 to June 30, 1891	208,963.64

Money statement.

July 1, 1890, balance unexpended	$502.11
Amount appropriated by act approved September 19, 1890	5,000.00
	5,502.11
June 30, 1891, amount expended during fiscal year	465.75
July 1, 1891, balance unexpended	5,036.36

G 5.

ICE-HARBOR AT HEAD OF DELAWARE BAY, DELAWARE.

The act of August 2, 1882, contained an appropriation of $25,000 for "ice-harbor at head of Delaware Bay, and for removal of sunken piers in channel back of Reedy Island, Delaware." The sum of $3,700 was expended in 1883 in removing the sunken piers at Reedy Island, and $5,063.07 has since been expended in surveys, examination, and office expenses.

Several plans for the formation of an ice-harbor in the vicinity of Liston Point have been proposed, but the difficulties connected with the problem have been such that a satisfactory solution has not yet been reached. Those who have studied the question are unanimous in the opinion that if such an ice-harbor is built it should be located in the reach of river between Reedy Island and Bombay Hook Point. This part of the river contains two localities, viz: Baker Shoal, and Duck Creek Flats, the improvement of which is provided for in the project for the permanent improvement of the Delaware River between Philadelphia and the sea by the construction of over 11 miles of dikes. The changes which would be induced in the regimen of this part of the river by such extensive constructions would render the prior location of an ice-harbor very hazardous.

The greatest need of commerce on the Delaware River is an improved ship channel between the port of Philadelphia and the sea, and until this shall have been carried further toward accomplishment, expenditures can be applied with more advantage to channel improvements than to ice-harbor construction.

The cost of an adequate ice-harbor in the vicinity of Liston Point would probably be from $400,000 to $600,000, and, after other requirements of commerce have been met, such an ice-harbor would be a desirable adjunct.

Total appropriation to June 30, 1891	$25,000.00
Total expenditures to June 30, 1891	8,763.07

Money statement.

July 1, 1890, balance unexpended	$16,276.93
June 30, 1891, amount expended during fiscal year	40.00
July 1, 1891, balance unexpended	16,236.93

G 6.

CONSTRUCTION OF IRON PIER IN DELAWARE BAY, NEAR LEWES, DELAWARE.

The construction of this pier was commenced in 1871 under an appropriation of $225,000 made in the river and harbor act of July 15, 1870. By the conditions of this act the Junction and Breakwater Railroad Company having the terminus of its line in the vicinity of the pier was permitted "to extend their railroad upon and over said pier, and to freely use said pier in connection with their said road, subject to such regulations and charges for maintenance and repairs as the Secretary of War may adopt." The pier was completed in 1880, and expenditures since that date have been applied to the repair and maintenance of the structure. The railroad company has not yet exercised its privilege of occupying the pier.

In 1888 and 1889, the pier was injured by the collision of vessels which had been driven from their moorings behind the adjacent breakwater by severe storms. About 120 linear feet of the pier was wrecked by these collisions, involving the destruction of 17 of the wrought-iron screw piles and their attachments.

Under date of October 10, 1889, the officer then in charge of the district reported the matter to the Department with an estimate of $10,000 for the repair of the pier. The act of April 4, 1890, providing "for certain of the most urgent deficiencies in the appropriations for the service of the Government for the fiscal year ending June 30, 1890, and for other purposes," contained the following item: "Constructing pier in Delaware Bay, near Lewes, Delaware: For repairs, $10,000."

The plan for repairing the pier, submitted in compliance with the instructions of the Department dated April 11, 1890, proposed removing the seventeen injured piles and replacing them with cast-iron columns, bolted to timber sills, sunk below the action of scour. The cast-iron caps and diagonal bracing attached to the injured piles were to be utilized upon the columns and the timber superstructure restored upon its former plan of construction. To guard against the recurrence of similar accidents from colliding vessels or wrecks in the future, it was proposed to place fender piles along both sides of the shore-arm of the pier. Timber on hand and stored upon the pier was to be used in these repairs. The approval of the above described project for the repair of the pier was received at the close of the fiscal year 1890.

Under date of August 23, 1890, a contract was entered into with the Alvin R. Morrison Company for the repair of the pier and the placing of fender piling along both sides of the shore-arm. This work was completed on March 14, 1891, at a cost of $7,033. The fender piles were driven to a depth of about 12 feet into the bottom through the aid of the water jet. The timber sills of the cast-iron columns consisted of two pieces of 12 inch by 12 inch creosoted timber, fastened together sidewise by oak treenails and iron clamps, and having a length sufficient to give about 14 square feet of bearing surface for each column. These sills were sunk by the aid of the water jet to a depth of 3 or 4 feet into the bottom; the cast-iron columns were bolted to the timber sills with phosphor bronze bolts, and after the columns and attached sills were sunk in position, they were loaded with a weight of 15 tons per column to secure them against subsequent settlement.

The bent and broken screw piles were removed by the use of the water jet, and it is of interest to note that these wrought-iron piles and their attached cast-iron screw flanges were without any indication of corrosion after having been in place for 17 years.

By these repairs the injured part of the pier is believed to be restored to its original strength. A large part of the timber superstructure has been in place from 10 to 12 years and its value is greatly impaired by natural decay and deterioration. The increased weight of engines and rolling stock which have arisen since the pier was designed make the wooden superstructure too light to bear such increased loads. This, in connection with the perishable character of the superstructure, would, if the pier is ever used by the railroad company, render necessary an iron superstructure adjusted to the demands of modern railroad requirements. Such a plan, in accordance with Senate resolution of March 12, 1886, was submitted under date of April 2, 1886 (see Report of the Chief of Engineers for 1886), at an estimated cost of $93,000.

The sundry civil act of March 3, 1891, contained the following provision:

> And the Secretary of War is hereby directed to assign to the Secretary of the Treasury so much space on the Lewes iron pier as may be necessary to enable the Marine Hospital Service to establish and conduct thereon such disinfection machinery as may be required for the proper disinfection of the cargoes of vessels detained at the quarantine, and when the breakwater shall have been completed then the said pier shall be permanently assigned to the Treasury Department: *Provided,* That such occupation and use of the pier by the Marine Hospital Service does not interfere with the engineering operations of the War Department in the completion of the breakwater improvement.

It is understood that the use of the pier as above provided will at times prohibit its use for any other purpose. The pier is of considerable value to vessels frequenting the breakwater harbor, being the only communication with the shore; it is necessary for the purposes of the Light-house Service; and its free use at all times will probably be indispensable for many years for the engineering operations of the War Department. It is therefore suggested that other arrangements be made for the requirements of the quarantine service.

The pier is in the collection district of Delaware, the nearest port of entry being Wilmington, where the amount of revenue collected during the year ending December 31, 1890, was $10,069.15. The nearest fort and light-house are, respectively, Fort Delaware and the Delaware Breakwater Light.

Total appropriations to June 30, 1891	$378,500.00
Total expenditures to June 30, 1891	378,077.55

Money statement.

July 1, 1890, balance unexpended	$10,046.34
June 30, 1891, amount expended during fiscal year	9,623.89
July 1, 1891, balance unexpended	422.45

Abstract of proposals for repairs to the United States iron pier in Delaware Bay near Lewes, Del., opened August 15, 1890, by Maj. C. W. Raymond, Corps of Engineers.

Approximate quantities.	Number, name, and address of bidder.	
	No. 1. William H. Virden, Lewes, Del.	No. 2. The Alvin R. Morrison Co., Wilmington, Del.
Furnish and place cast-iron columns and cast-iron caps (18,000 pounds) per pound	$0.09	$0.12
Place cast-iron caps furnished by the United States (3,500 pounds) per pound	.05	.04
Place pine timber furnished by the United States in foundation sills, superstructure, and fender pile-bearing plates (71,400 feet B. M) per 1,000 ft. B. M	35.00	25.00
Furnish and place phosphor bronze screw bolts (1,000 pounds) per pound	.50	.35
Furnish and place wrought-iron screw-bolts in fender piling (6,000 pounds) per pound	.06½	.04
Furnish and place wrought-iron diagonal braces and their attachments or any part thereof (2,000 pounds) per pound	.16	.07
Place wrought-iron diagonal braces and their attachments, or any part thereof, furnished by the United States (5,000 pounds) per pound	.10	.04
Place fender piles furnished by the United States (7,000 linear feet) per linear foot	.07	.13
Furnish and place wrought-iron spikes (400 pounds) per pound	.05	.03
Amount	6,514.00	5,937.00

Contract (dated August 23, 1890) entered into with The Alvin R. Morrison Company.

G 7.

IMPROVEMENT OF HARBOR AT DELAWARE BREAKWATER, DELAWARE.

At the beginning of the last fiscal year available funds were practically exhausted. The river and harbor act of September 19, 1890, appropriated $80,000 for the continuation of this improvement.

The work in progress since 1883 has had for its object the closing of the gap of about 1,350 feet between the breakwater and ice-breaker by the deposition of random stone. At the close of the fiscal year of 1890, 101,713 gross tons of stone had been placed in the gap.

Under date of February 12, 1890, Lieut. Col. Henry M. Robert, then in charge, submitted a revised project for the work remaining to be done, which was approved by the Department on February 20, 1890. This project is published in the Annual Report of the Chief of Engineers for 1890. The revised project proposed that the random stone substructure should be completed with a sea slope of 1 vertical to 2 horizontal, and harbor slope of 1 vertical to 1⅓ horizontal; the top of the superstructure to be 62 feet wide and 15 feet below mean low water. The concrete superstructure to have a cross section of 27 feet high and 27 feet wide, with its top 7½ feet above mean low water. The superstructure, from its base to a height of about 2 feet above high water, to be built of concrete blocks; the remaining 5½ feet of height to consist of concrete in mass. The estimated cost of completing the work in accordance with this project was $500,000.

During the season of 1890 a detailed survey was made of the gap to determine the height to which the random stone substructure had been brought by the stone already deposited. From the information furnished by this survey a study was made of the requirements of the revised project and its application to the closure of the gap, and the conclusion was reached that a modification of the approved project could with advantage be made.

Under date of March 31, 1891, a modified project was submitted to the Department, which was approved April 4, 1891. It proposes the closing of the gap by the deposition of random stone, so as to raise the structure to a height of 14 feet above the plane of low water, with a width at top of 20 feet; the width at low water to be 40 feet and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7, formed by heavy stones laid in position. The estimated cost of the work is $400,000. This project is appended hereto.

Under date of May 26, 1891, a contract was entered into with The Brandywine Granite Company, of Wilmington, Del., for furnishing and depositing stone in the gap, in furtherance of the approved project, to the extent of available funds, or about $75,000. In the work to be done under this contract the deposition of stone is to commence at the ice-breaker and be continously completed to the height of low water over a width of 40 feet, measured transversely to the axis of the gap.

At the close of the fiscal year the quarrying of stone to be deposited under this contract was in progress.

In the 63 years which have elapsed since the Delaware Breakwater was first planned, great changes have ensued in the character, dimensions, and draft of the vessels for which protection was required and provision made. In addition to this change of requirements the deep-water area then available for anchorage behind the breakwater has been greatly reduced by shoaling.

From these continued causes a necessity has arisen for a more ample harbor of refuge whereby protection can be given to the deep-draft vessels passing this part of the Atlantic coast, and in expression of this need Congress, in the river and harbor act of September 19, 1890, provided for an examination of Delaware Bay with a view of determining the best site for a national harbor of refuge suitable for deep-draft vessels.

Even assuming that such a deep-water harbor of refuge will become an accomplished fact, there nevertheless remains the necessity for completing the existing project of the present breakwater, whereby increased accommodation will be given to the four or five thousand fishing vessels and smaller coasting craft which yearly use the harbor, and with advantage can continue to do so even after a more capacious harbor is built in the vicinity.

The Maritime Exchange of Philadelphia maintains a station on the breakwater, and through telegraph cables between the mainland and their station are in connection with the shipping of the harbor. The reports of the Maritime Exchange state that during the year 1890, 2,250 vessels, exclusive of tugs, fishing, and small coasting craft, anchored under the protection of the breakwater.

If funds are available, it is proposed during the next fiscal year to continue the work required for closing the gap to the plane of low water, and possibly for raising a part of the work to its full height.

This work is situated in the collection district of Delaware. Wilmington is the nearest port of entry, at which the revenue collected during the year ending December 31, 1890, was $10,069.15. Fort Delaware is the nearest fort, and the Breakwater Light the nearest light-house.

Total appropriations to June 30, 1891	$2,628,353.70
Total expenditures to June 30, 1891	2,549,155.79
Total appropriations under present project to June 30, 1891	436,250.00
Total expenditures under present project to June 30, 1891	357,052.09

Money statement.

July 1, 1890, balance unexpended	$1,227.78
Amount appropriated by act approved September 19, 1890	80,000.00
	81,227.78
June 30, 1891, amount expended during fiscal year	2,029.87
July 1, 1891, balance unexpended	79,197.91
July 1, 1891, amount covered by uncompleted contracts	75,082.00
July 1, 1891, balance available	4,115.91
Amount (estimated) required for completion of existing project	320,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	320,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and depositing stone in the gap at the Delaware Breakwater, Delaware, opened May 20, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity 34,600 tons.	Amount.
		Price per ton.	
1	The Brandywine Granite Company, Wilmington, Del	$2.17	$75,082

Contract (dated May 26, 1891) entered into with the Brandywine Granite Company; in progress.

REVISED PROJECT FOR IMPROVING DELAWARE BREAKWATER, WITH REFERENCE TO THE PLAN OF CLOSING THE GAP BETWEEN THE BREAKWATER AND ICE-BREAKER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., March 31, 1891.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following project for the expenditure of the sum of $80,000 appropriated in the river and harbor act of September 19, 1890, for improving Delaware Breakwater, Delaware—continuing improvement.

During the months of July and August, 1890, a detailed survey was made of the substructure for the proposed extension of this work, and the preparation of this project has been necessarily delayed until the results of this survey could be thoroughly investigated.

The work in its present condition consists of two detached structures of random stone rising about 13½ feet above high water, called respectively, the breakwater and the ice-breaker. These structures are separated by a gap about 1,350 feet in length.

The approved project contemplates the closing of the gap by the construction of a connecting breakwater, consisting of a substructure of random stone and a superstructure of concrete.

The substructure is to have a sea slope of 1 vertical to 2 horizontal, and a harbor slope of 1 vertical to 1⅓ horizontal, the top to be 62 feet wide and 15 feet below mean low water.

The superstructure is to be 27 feet high and 27 feet wide and rectangular in cross-section. It is to be built of concrete blocks from its base to a height of about 2 feet above high water, the remaining 5½ feet of height to consist of concrete in mass.

The cost of completing the work is estimated at $500,000.

Since 1884, when work was commenced under this general project, 101,713 gross tons of stone have been placed in the gap for the formation of the proposed substructure. The recent survey shows that no additional material is required to bring the top of the work to the proposed level of 15 feet below low water, but it will be necessary to rearrange about 2,700 tons of stone which are now above that level.

The moving of this stone and the leveling of the upper surface of the substructure will be expensive and difficult. The site is much exposed and over 1 mile from the shore, and the ebb currents through the gap are very strong. The work can only be conducted during favorable weather and at certain stages of the tide. I doubt whether a contract can be made for the execution of this work at any reasonable price. In my opinion it will have to be done by hired labor; and as it will be subject to great delays, during which the working parties (including expensive divers) must be maintained under pay, the ultimate cost can not be even approximately determined. If the improvement is to be continued under the existing project the funds now available should be applied to this work.

The existing project is based upon a very thorough study of the data available at the time of its preparation, and I should hesitate to recommend its modification had not the survey of 1890 furnished new and more accurate information. The results of that survey, however, seem to require a rediscussion of the problem, and accordingly I respectfully submit the following suggestions for the consideration of the Department:

The adopted project is contained in the report of Lieut. Col. Henry

M. Robert, Corps of Engineers, dated February 12, 1890, which is published in the Annual Report of the Chief of Engineers for 1890, Part I, page 891. The previous project provided for the construction of a superstructure of concrete in place, and Colonel Robert points out the objections to that method. It is to be remarked, however, that in the adopted project the difficulties indicated are not entirely obviated, since the concrete capping proposed will contain about 7,500 cubic yards of concrete, which would have to be mixed upon the breakwater. This would require as much plant as if the whole superstructure were to be thus constructed. In the light of the most recent experience, however, the plan of constructing the superstructure of concrete blocks is much more satisfactory than that of forming it of concrete in place. The only question is whether, under the peculiar conditions of this locality, it is not better and more economical to complete the structure with random stone, in accordance with the plan of the original work, than to attempt the use of concrete in any way whatever.

If the superstructure is to be built of concrete blocks, it is assumed that the arrangement adopted will be that of sloping blocks, employed in nearly all recent works where the superstructure is founded below low water. A full description of the cross-sections of recent English works constructed on this plan is given in the report of Mr. L. Y. Schermerhorn, assistant engineer, in the Annual Report of the Chief of Engineers for 1890, Part I, page 894. The breakwaters constructed by French engineers at the island of Réunion are of the same character, and have been carefully studied in order to obtain the results of the most recent practice.

This plan requires the following operations:

1. *The material at the top of the substructure must be rearranged and leveled.* I have already referred to the difficulty and uncertainty attending the execution and cost of this part of the work.

2. *The concrete blocks must be manufactured and delivered.* The nearest point where the blocks could be made, and from which they could be transported to the work by water, is probably Wilmington. The larger blocks should each weigh about 30 tons. The economical manufacture of good blocks of this size will require expensive plant and the greatest care in testing cement and inspecting the work. The blocks will have to be kept on hand for several months to insure proper setting before use. They will have to be transported by water a distance of about 75 miles to the work, where arrangements must be made for unloading and temporarily storing them.

3. *The ends of the superstructures of the breakwater and the ice-breaker must be prepared for junction with the ends of the new superstructure.* This may perhaps be accomplished by laying up the stones in as regular courses as possible, but the work will be troublesome and expensive. The planes of junction will always be positions of weakness. This is especially the case at the end of the breakwater, where there will be a reëntrant angle, which will probably require for its protection the deposit of a large amount of random stone.

4. *Plant must be established for handling the blocks and they must be placed in position.* There is no precedent for the construction of an offshore breakwater on the sloping-block system. All the breakwaters built on this plan have started from the shore, and this fact has determined the character of the plant employed. Thus at Colombo, Madras, Mormugoa, Manora, Kustendjie, and Réunion the blocks were placed in position by large and costly overhanging balance cranes called "Titans," which traveled on railways along the breakwaters, and could be

run on shore during seasons of exposure when the work was not in progress. These machines are not adapted to the work at the Delaware Breakwater, for their peculiar advantages are entirely lost in an offshore construction. The exposure of the site to the action of waves and currents, and the necessity for accurate adjustment imposed by the sloping-block system, render the use of floating appliances entirely out of the question. I am of the opinion that the simplest, safest, and cheapest method to follow in this case will be to use a cable hoist extending across the gap. These hoists have been recently employed with success at many places for handling large and heavy masses; for example, at the Tilly Foster Iron mine, the Sodom Dam, and at numerous mines and stone quarries both in the United States and Europe.

The cable hoist manufactured by the Trenton Iron Company has been taken as a basis for estimate, and I am greatly indebted to Mr. E. Gybbon Spilsbury, the managing director of that company, for a careful study of the arrangements necessary for the proposed work. These arrangements require only a brief general description in this report. They are shown in figure 1, on the accompanying sketch.

The cable hoist consists of a system of suspended steel wire cables, which pass over towers and are firmly anchored at each end. By means of an endless traction rope wound upon a drum, a carriage is moved along the suspended cables in either direction, and may be stopped at any point. Hoisting ropes supported by trolleys lift the load, which can be transported to, and raised or lowered at, any point on the line. The traction and hoisting apparatus is operated by an engine located at either end of the line. The hoist designed for the Delaware Breakwater is calculated to raise with safety a load of 30 tons, and not only transport it in the direction of the axis of the work, but also shift it transversely to that axis for a distance of 30 feet.

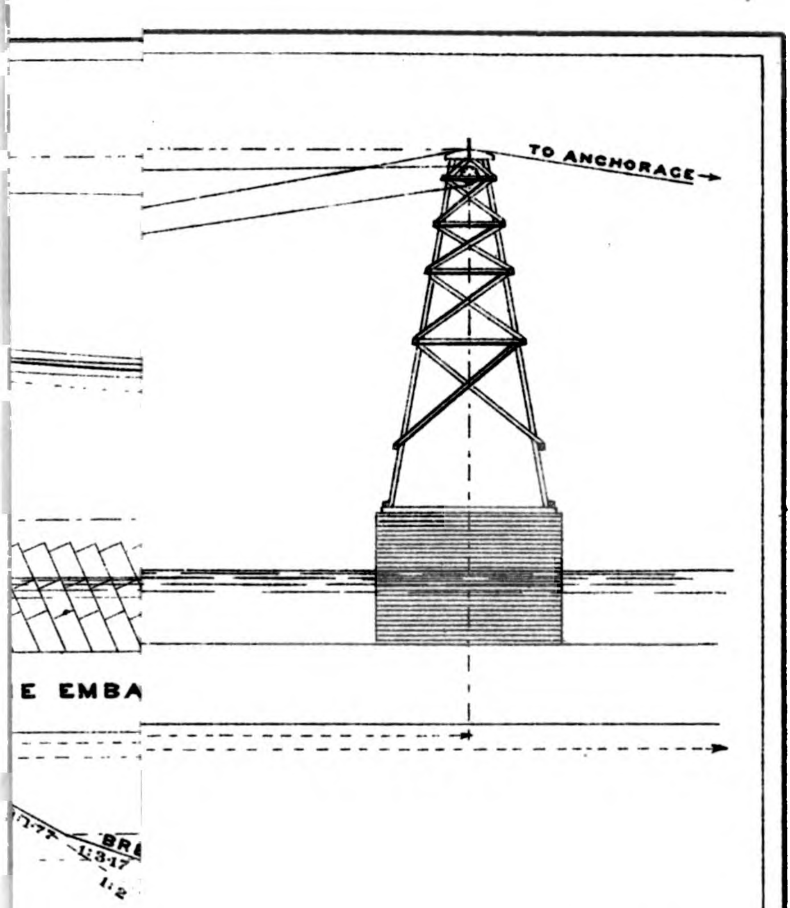
The span of the gap is too great for the economical use of this system. In the execution of the approved project, it is therefore proposed to build a temporary pier in the middle of the gap, reducing the span to about 675 feet. This pier is to be built of the creosoted timber now on hand at the breakwater, and filled with rubble stone. The towers are to be first erected on this pier and on the end of the ice-breaker. One anchorage is near the ice-breaker and the other on the breakwater. The hoisting engine will be placed on the ice-breaker.

When the superstructure between the ice-breaker and the pier has been completed, it is proposed to move the tower and engine from the ice-breaker to the end of the superstructure and the tower from the pier to the end of the breakwater, and reëstablish the hoist in this position. The pier will then be removed and the remaining portion of the superstructure will be constructed.

The advantages of this method of construction are apparent. The boats conveying the blocks to the work can be unloaded at any point under the hoist and the blocks can be laid anywhere on the enrockment and subsequently raised and placed in position at any time. The cables are above the action of the sea, and can be removed during the winter if it is found desirable. Thus the injuries to which the plant employed at other works has been exposed will be avoided. The plant is less complicated and less expensive than that which has heretofore been employed for handling large concrete blocks. Recent improvements in the manufacture of steel cables justify its adoption even for the movement of masses as heavy as those contemplated in this project.

The estimated cost of the complete plant in position, including the temporary pier, in $40,000.

5. *Plant must be established on the breakwater for the manufacture of*



ompany annual report for 1891.

C. W. Raymond
Major of Engineers

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concrete, and the concrete top of the superstructure must be formed in place. This work should not be undertaken until the blocks of the superstructure have settled for at least two years.

6. *A quantity of very large rubble stone must be placed on the sea side, at the foot of the superstructure.*—This quantity is estimated by Colonel Robert at 10,000 tons.

Some of the operations above mentioned are of such a character that it is impossible to make even an approximate estimate of their cost. If the work is done by contract, the contractor must receive very high prices to cover him from possible loss from delays caused by unfavorable weather and damages due to storms. Moreover, no contractor would be willing to incur the great expense of establishing the plant necessary for the economical manufacture of the blocks and for the construction of the superstructure unless his contract covered the execution of the whole work. In the proposals for the work, no competition can be expected, since the only convenient approach by water is the Delaware River, and the nearest point on the river where the blocks can be economically manufactured is at Wilmington. If it is practicable to carry out the project at all under these circumstances, I am of the opinion that the estimate of $500,000 given by Colonel Robert for its completion is the minimum cost possible, and I consider it probable that the cost will exceed that amount.

This project for a concrete superstructure was adopted because it was considered much less expensive than the construction of a superstructure of random stone. This conclusion was based upon two assumptions: (1) that 1.5 gross tons of stone are required for every cubic yard of volume in the breakwater; and (2) that as the present slopes of the breakwater are slopes of equilibrium resulting from wave action, it is not safe to assume a cross-section for the new structure having a less area than that of the existing breakwater.

The first assumption is based upon a careful determination of the volumes of the breakwater and icebreaker made in 1886. Their combined volume was found to be 595,000 cubic yards. From the records of the work, it appears that 892,528 gross tons were deposited in its construction. These figures indicate that 1.5 gross tons are required for each cubic yard of enrockment.

From the recent survey the volume of the embankment in the gap is found to be 86,700 cubic yards. For its formation 101,713 gross tons of stone were deposited. These figures indicate that only 1.17 gross tons are required for each cubic yard of enrockment.

From a careful measurement of the volume of a large quantity of stone weighed onto the barges of the Brandywine Granite Company under the close supervision of this office, it was found that the weight of a cubic yard of random stone similar to that placed in the gap was 1.15 gross tons.

It may be worthy of mention that the common practice in railroad work is to assume that 1 cubic yard of rock in place equals 1.7 cubic yards of settled embankment. A solid cubic yard of the rock placed in the gap weighs about 2 gross tons. Hence a cubic yard of the embankment would contain 1.18 gross tons.

These considerations appear to justify the assumption of 1.17 gross tons per cubic yard as the embankment weight of the stone used in this work. If it is increased to 1.25 tons per cubic yard, ample allowance will be made for settlement and loss of stone outside the calculated slopes. The discrepancy between this determination and the former one may be, to some extent, accounted for as follows: In computing the volumes of the structures, they were assumed to rest upon the bottom of the bay as it existed before the commencement of the work. They were, however, not founded on mattresses, as is the case with the work in the gap, and a considerable quantity of material doubtless lies below the assumed foundation. There has been great scour at the four exposed ends of the structures, and the material which has fallen into the holes thus formed has from time to time been replaced. Other material, deposited too far from the axis of the enrockment, may have been carried off by the sea. It may be remarked that the structure in the gap is not subject to these causes of loss, since it is founded on mattresses and it is without exposed ends.

The second assumption above referred to, that the cross-section of the existing breakwater has been determined by the forces of the sea and is the minimum cross section which can be safely adopted, is also open to some question. The early records of the work indicate that certain sections were adopted, but unfortunately these sections can not now be found. It appears, however, that their forms and dimensions were principally based upon a study of the long, flat slopes of the Cherbourg Breakwater, at that time the only practical example of an extensive random stone off-shore breakwater. It is true that the project contemplated the deposit of the material within certain well-defined limits; but the methods of unloading employed were not such as to render an accurate emplacement possible. The difference between the mean cross-sectional areas of the breakwater and the ice-breaker, shown in figure 3, on the accompanying sketch, is perhaps not entirely due to difference of exposure.

The present slopes on the sea side of the breakwater are doubtless determined by wave action, but the cross-sectional area is probably the result not only of this action, but also of the location of the stone when originally deposited. Most of the material in the breakwater is protected from the action of the sea and serves simply to hold the exposed slopes in position. It seems therefore probable that a less amount of material differently deposited might be found to have the necessary stability.

The cross-section shown in Figure 2 on the accompanying sketch is suggested as one which, if properly constructed, might be found to have sufficient dimensions. The outer and inner slopes have the same inclinations as those of the existing breakwater. The width at low water is 40 feet, and it is proposed to lay up the slopes of the superstructure above this level, forming those on the sea side of stones of the largest dimensions laid endwise, so as to expose as little surface as possible to the action of the sea. If such a structure can be made to stand, it will result in a great saving in the amount of material required.

In the formation of the mound to the level of low water, the stone should be deposited within the limits of the assumed low-water width, and as near as possible to the axis of the embankment. Careful observations during the progress of the work would determine the feasibility of the proposed superstructure.

Assuming that each cubic yard of settled enrockment will contain 1.25 gross tons of stone, there will be required, in addition to the material now in place, 79,000 tons below low water and 27,000 tons above low water. The cost of completing the work in accordance with this project is therefore estimated as follows:

79,000 tons of stone at $3 per ton	$237,000
27,000 tons of stone at $4 per ton	108,000
Contingencies	55,000
Total	400,000

I will now briefly compare the two projects.

1. *Cost.*—The cost of the concrete method of construction is estimated at $500,000, but this estimate is very uncertain and should be considered a minimum. The cost of the rubble method is estimated at $400,000. The latter method will, in my opinion, prove much more economical than the former, even should it be found necessary to increase the dimensions now proposed. It will be less expensive than the concrete method, even if we assume the previously adopted value of 1.5 tons of stone to the cubic yard.

2. *Facility of construction.*—The concrete method requires expensive plant, has never been employed in breakwater construction under similar circumstances, is subject to great uncertainties in its execution, and the work can only be economically conducted with very large appropriations.

The rubble method is simple in character, requires plant which can be readily obtained, is subject to no uncertainties in its execution and can be carried on with small appropriations if necessary.

3. *Facility of repair.*—The principal injuries to which concrete breakwaters founded on rubble mounds below low water are exposed are due to the displacement of the rubble below the foundation. For this reason the best modern practice, based on experience, places the foundation of the concrete superstructure from 20 to 22 feet below low water. According to this practice and experience, there is no doubt that the foundation level of 15 feet below low water is above the limit of safety. It cannot be lowered without great expense. Should the concrete superstructure be completed from this level it might stand a long time without injury, but should a storm of exceptional violence remove the rubble from beneath it the results would be disastrous. The plant for the execution of the repairs would probably not be on hand and could only be obtained at great expense.

A rubble structure, no matter how severe the injuries it may suffer, can be quickly and simply repaired by the deposit of stone, with plant easily obtained.

4. *Time required to complete the work.*—Assuming funds to become available as rapidly as needed, it will probably require at least 5 years, and perhaps much longer, to complete the work with the concrete method.

With the rubble method, the work can be completed in 2 years. In accordance with the above views, I have the honor to recommend the adoption of the following project for completing the Delaware Breakwater:

REVISED PROJECT.

Rubble mound.—This mound to be raised to the level of mean low water by the deposit of random stone, to have a width of 40 feet at that level and such slopes as may be formed by the action of the sea.

Superstructure.—The structure above low water to be 14 feet high and 20 feet wide at top, with slopes of about 1 on 0.7 formed by heavy stones laid in position, the interior space to be filled with rubble.

The estimated cost of the work is $400,000.

Should this project receive the approval of the Department, I have the honor to recommend that the sum of $80,000 now available be applied to raising a portion of the existing substructure in the gap to the plane of mean low water by the deposit of random stone.

It is proposed to do the work by contract after advertising 30 days for proposals, such method being considered most economical and advantageous to the Government.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., April 2, 1891.

Respectfully submitted to the Chief of Engineers. This proposition for the expenditure of the last appropriation of $80,000 in the act of September 19, 1890, for continuing the construction of the existing Delaware Breakwater involves a modification of the approved project.

The work remaining to be done is to close the gap between the existing structures called the ice-breaker and the breakwater, and is in accordance with the recommendations of a Board of Engineer Officers, dated August 29, 1872, of which I was the junior member. It was understood, while not stated in the report, that the new structure would be of natural and not artificial stone, though it was deemed best to leave that point for future determination.

The project at present approved is to make the closure of the gap by a work consisting of a substructure of random stone and a superstructure of concrete, the top of the latter to be a monolith.

In my opinion, considering the exposure of the locality and the latest experience in the use of concrete, natural stone should be preferred as the material for what remains to be done. And this view is strengthened by the special difficulties of the use of concrete at this place. Moreover, the natural stone gives the cheaper structure with greater probabilities of endurance and less difficulty of repairs if needed.

Major Raymond's revised project for the completion of the work is recommended for approval, as also his proposition for the special application of the last appropriation in accordance therewith.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers, U. S. A.

G 8.

IMPROVEMENT OF RANCOCAS RIVER, NEW JERSEY.

The Rancocas River discharges into the Delaware River at a point opposite the northern limits of the city of Philadelphia and about12 miles above the foot of Market street. The project for its improvement was made in 1881, and proposed the formation of a channel from 150 to 200 feet wide with a low-water depth of 6 feet from its mouth to Centerton, a distance of about 7½ miles, and from thence to Mount Holly a 5-foot low-water channel. The estimated cost of the improvement was $81,236.

The river and harbor acts of 1881 and 1882 appropriated $20,000 for the work, and this amount was expended between 1881 and 1884 in the improvement of Coats Bar, the most marked obstruction on the lower river.

The river and harbor act of September 19, 1890, contained an appropriation of $250,000 for improving Delaware River, Pennsylvania and New Jersey, of which $10,000 "shall be expended in continuing improvement on the Rancocas River, one of the tidal tributaries of said river."

Under date of March 4, 1891, a contract was entered into with Frank C. Somers for the removal by dredging of about 35,000 cubic yards of material in the formation of a channel 6 feet deep at mean low water, and about 100 feet wide at the following localities between the mouth and Centerton, viz: At Sharp Island, below Mill Creek, below Lime Kiln Wharf, and at Centerton. The contract further provided for the removal of three wrecks, which for a long time had been obstructions to navigation, lying between the railroad bridge at Delanco and the junction of the Lumberton and Mount Holly branches of the river. This contract was completed May 27, 1891, by the removal of the three wrecks and 32,749 cubic yards of material from the localities above named. By this work a channel of navigable width and 6 feet deep at low water has been formed between the mouth and Centerton.

With the balance of available funds, about $1,200, an effort will be made to improve the channel above Centerton, in the Mount Holly branch of the Rancocas River, by the removal of the most marked obstructions in this reach of the river.

This work is situated in the collection district of Trenton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1890. The nearest fort is Fort Mifflin, and the Horseshoe Lights are the nearest light-houses.

Total appropriations to June 30, 1891	$30,000.00
Total expenditures to June 30, 1891	28,702.64

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	8,802.73
July 1, 1891, balance unexpended	1,197.27
Amount (estimated) required for completion of existing project	51,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging and removal of wrecks in Rancocas River, New Jersey, opened February 24, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed, 35,000 cubic yards.	Amount.	Price of removal of wrecks.			Total amount of bid.
				Canal boat above railroad bridge at Delanco.	Canal boat below highway bridge at Bridgeboro.	Part of sloop below junction of the Lumberton and Mt. Holly branches.	
		Per cu. yd.					
1	American Dredging Company, Philadelphia, Pa.	$0.23	$8,050.00	$350	$300	$200	$8,900.00
2	Edgar M. Payn, Albany, N. Y.	.24⅞	8,706.25	500	500	475	10,181.25
3	Frank C. Somers, Camden, N. J.	.22	7,700.00	300	300	200	8,500.00

Contract (dated March 4, 1891) entered into with Frank C. Somers.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1890.

Kind of vessel.	Arrivals.		Departures.	
	No.	Ton.	No.	Ton.
Steamers	410	85,000	410	85,000
Sailing vessels	1,560	82,000	1,560	82,000
Barges	816	130,000	816	130,000
Canal boats	1,355	106,000	1,355	106,000
Total	4,141	403,000	4,141	403,000

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
RECEIVED.			SHIPPED.		
Coal	13,000	$52,000	Sand	125,000	$125,000
Lumber	1,000	12,000	Vegetables	5,400	150,000
Manure	7,000	7,000	Provisions	3,000	160,000
Lime	3,900	40,000	Chemicals	2,000	20,000
Chemicals	1,000	10,000	Miscellaneous	6,000	220,000
Miscellaneous	4,000	240,000			
Total	29,900	361,000	Total	141,400	675,000

G 9.

IMPROVEMENT OF ALLOWAY CREEK, NEW JERSEY.

The river and harbor act of September 19, 1890, contained an appropriation of $6,000 for the improvement of Alloway Creek, New Jersey; this was the first appropriation made for the work.

Alloway Creek discharges into the Delaware River at a point about 7 miles below Fort Delaware. The project for its improvement was based upon a survey made in 1889, and proposed the improvement of the stream between Quinton, N. J., and its mouth, a distance of 10½ miles, by the formation, by dredging, of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; from thence a channel of the same depth and 75 feet wide to the lower side of the bar at the Square. At a locality in the creek known as the Canal, in addition to obtaining a channel of the dimensions above named, the width of the stream is to be increased to about 150 feet between its low-water lines. At the Square the dredged channel is to be supplemented by a deflecting dike about 500 feet in length, formed of the material dredged from the adjacent bar, with its channel face protected by a riprap of stone. The estimated cost of the work was $25,000.

Under date of March 4, 1891, a contract was made with Frank C. Somers for the removal by dredging of about 25,000 cubic yards of material, at 18 cents per cubic yard, from the shoal areas at the Square, Canal, and Upper Hancock Bridge. At the close of the fiscal year 18,341 cubic yards had been removed under this contract.

This work is situated in the collection district of Bridgeton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1890. The nearest fort is Fort Delaware, and the Reedy Island light is the nearest light-house.

Total appropriations to June 30, 1891	$6,000.00
Total expenditures to June 30, 1891	3,467.88

Money statement.

Amount appropriated by act approved September 19, 1890		$6,000.00
June 30, 1891, amount expended during fiscal year		3,467.88
July 1, 1891, balance unexpended		2,532.12
July 1, 1891, outstanding liabilities	$330.14	
July 1, 1891, amount covered by uncompleted contracts	1,198.62	
		1,528.76
July 1, 1891, balance available		1,003.36
Amount (estimated) required for completion of existing project		19,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		19,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Alloway Creek, New Jersey, opened February 23, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed (25,000 cubic yards).	Amount.
		Per cu. yd.	
1	**Frank C. Somers**, Camden, N. J	$0.18	$4,500
2	**American Dredging Company**, Philadelphia, Pa	.22	5,500
3	**Atlas Dredging Company**, Wilmington, Del	.20	5,000
4	**National Dredging Company**, Wilmington, Del	.23	5,750

Contract (dated March 4, 1891) entered into with Frank C. Somers. In progress.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1890.

Kind of vessel.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
Steamers	100	10,500	100	10,500
Sailing vessels	45	4,500	45	4,500
Canal-boats	15	2,250	15	2,250
Total	160	17,250	160	17,250

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
RECEIVED.			SHIPPED.		
Coal	8,000	$27,000	**Manufactured products**	7,000	$350,000
Glass sand	1,500	2,250	**Miscellaneous**	2,000	10,000
Tin plate	800	80,000			
Lumber	1,400	16,000			
Soda ash	400	12,000			
Miscellaneous	3,000	6,000			
Total	15,100	143,250	Total	9,000	360,000

G 10.

IMPROVEMENT OF MAURICE RIVER, NEW JERSEY.

The river and harbor act of September 19, 1890, contained an appropriation of $8,000 for continuing this improvement. The work was formerly embraced in the district of Maj. W. F. Smith, U. S. agent, and was transferred to my charge on October 2, 1890.

The project for its improvement proposes the formation, by dredging, of a 6-foot low-water channel 100 feet wide from a point about 4 miles below Millville to the head of navigation at Millville. Between the mouth of the river and the lower limit of the project, a distance of about 20 miles, the channel in its natural condition carries a low-water depth of over 10 feet.

During the past fiscal year under an open market agreement with the American Dredging Company, dated February 23, 1890, 6,785 cubic yards of sand and gravel, measured in place, were excavated from the channel above the Millville Bridge and deposited on the adjacent bank of the river. The work done under this agreement was completed July 14, 1890, by the aggregate removal of 56,703 cubic yards at the rate of 15 cents per cubic yard, measured in place. This work was applied to the extension of the 6-foot channel to a point about 1,400 feet above the Millville Bridge.

The work yet remaining to be done to complete the project is the further extension, by dredging, of the 6-foot channel to the head of navigation, or for a distance of about 1,300 feet, involving the removal of about 25,000 cubic yards of material.

On February 23, 1891, proposals were received for the above-described work, for which the American Dredging Company bid 19 cents per cubic yard on the basis of deferring the commencement of operations until December, 1891. The only other bid received was for 28 cents per cubic yard. The lowest proposal not being in accordance with the time named in the specifications for the commencement of the work was considered informal, and the remaining proposal was considered excessive. The bids were therefore rejected, and the work readvertised.

Under date of May 22, 1891, a contract was entered into with the American Dredging Company at the rate of 19 cents per cubic yard under specifications which defer the commencement of work to December, 1891.

This work is situated in the collection district of Bridgeton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1890. The nearest fort is Fort Delaware, and the Maurice River Light is the nearest light-house.

Total appropriations to June 30, 1891	$43,000.00
Total expenditure to June 30, 1891	34,916.23

Money statement.

July 1, 1890, balance unexpended	$6,183.17
Amount appropriated by act approved September 19, 1890	8,000.00
	14,183.17
June 30, 1891, amount expended during fiscal year	6,099.40
July 1, 1891, balance unexpended	8,083.77
July 1, 1891, amount covered by uncompleted contracts	4,750.00
July 1, 1891, balance available	3,333.77

Abstract of proposals for dredging in Maurice River, New Jersey, opened February 23, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed (25,000 cubic yards).	Amount.
		Per cu. yd.	
1	American Dredging Company, Philadelphia, Pa	$0.19	$4,750
2	Frank C. Somers, Camden, N. J	.28	7,000

Both bids rejected; lowest informal; the other, price too high.

Abstract of proposals for dredging in Maurice River, New Jersey, opened May 13, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantity of material to be removed (25,000 cubic yards).	Amount.
		Per cu. yd.	
1	American Dredging Company, Philadelphia, Pa	$0.19	$4,750
2	Atlas Dredging Company, Wilmington, Del	.23	5,750

Contract (dated May 22, 1891) entered into with American Dredging Company. Work not yet commenced.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1890.

Kind of vessel.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
Steamers	36	3,600	36	3,600
Sailing vessels	840	120,000	840	120,000
Total	876	123,600	876	123,600

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
RECEIVED.			SHIPPED.		
Coal	10,000	$40,000	Oysters	48,000	$600,000
Iron	9,700	174,000	Gravel and sand	65,500	98,000
Hay	1,800	11,000	Wood	6,500	12,000
Glass sand	3,000	9,000	Clay	3,500	43,000
Cotton	400	80,000	Iron pipe	8,000	240,000
Fertilizers	600	18,000	Lumber	400	4,000
Bricks	2,900	11,000	Hay	200	2,000
Lumber	5,600	37,000			
Grain	3,000	92,000			
Total	37,000	472,000	Total	132,100	999,000

G 11.

REMOVAL OF WRECKS FROM DELAWARE BAY AND RIVER.

The act of January 23, 1880, appropriated $25,000 for the removal of the wrecks of ten vessels which foundered at Delaware Breakwater Harbor in October, 1877. Eight of these wrecks were removed in 1880, 1881, and 1882, the remaining two disappearing as obstructions to navigation. The act of August 2, 1882, made the balance of the appropriation available for the removal of any wrecks then or thereafter existing in Delaware Bay or River.

In 1886 and 1888 three additional wrecks were removed from the vicinity of Delaware Breakwater Harbor under this appropriation. During the past fiscal year no wrecks have been removed under this appropriation.

In accordance with instructions the balance on hand, $734.08, was returned to the Treasury to the credit of the appropriation on March 12, 1891.

Money statement.

July 1, 1890, balance unexpended	$734.08
July 1, 1891, balance unexpended	734.08

G 12.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

During the past fiscal year two wrecks have been removed under the authority of the act of Congress approved June 14, 1880.

In May, 1889, the schooner *Gen. W. T. Sherman* was sunk in Delaware Bay, near Fortesque Beach, New Jersey, in about 10 feet of water; the wreck was a dangerous obstruction to the coasting trade. Under date of July 19, 1890, a contract was made with Frank C. Somers for the removal of the wreck for the sum of $345. The work was completed on July 31, 1890.

In January, 1875, the steamer *Mediator* was sunk in Barnegat Inlet, New Jersey; subsequently the change in the position of the channel of entrance made the wreck a dangerous obstruction to navigation. Under date of September 19, 1890, a contract was made with John Townsend for the removal of the wreck for the sum of $1,449. The work was completed October 16, 1890.

In April, 1891, a scow was sunk in the Rancocas River, New Jersey, near the railroad drawbridge at Delanco. The wreck being a dangerous obstruction to all vessels passing through the draw its removal was recommended. Under date of June 24, 1891, a contract was made with Enoch Townsend for the removal of the wreck for the sum of $345. At the close of the fiscal year the work of removal of this wreck was in progress.

Abstract of proposals for removal of the wreck of the schooner Gen. W. T. Sherman, lying in Delaware Bay, near Fortesque Beach, New Jersey, opened July 10, 1890, by Maj. C. W. Raymond, Corps of Engineers

No.	Name and address of bidder.	Price.
1	Frank C. Somers, Camden, N. J	$345
2	American Dredging Company, Philadelphia, Pa	490
3	John Townsend, Somers Point, N. J	498
4	George M. Register, Lewes, Del	770
5	Charles W. Johnston, Lewes, Del	745
6	Joseph D. Truxton, Lewes, Del	1,190

Contract (dated July 19, 1890) entered into with Frank C. Somers.

Abstract of proposals for removal of the wreck of the steamer Mediator, lying in Barnegat Inlet, New Jersey, opened August 11, 1890, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Price.
1	Charles W. Johnston, Lewes, Del	$1,589
2	George W. Townsend, Boston, Mass	2,494

All bids rejected; prices too high.

Abstract of proposals for removal of the wreck of the steamer Mediator, lying in Barnegat Inlet, New Jersey, opened September 5, 1890, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Price.
1	George W. Townsend, Boston, Mass	$2,400
2	John Townsend, Somers Point, N. J	1,449
3	Charles W. Johnston, Lewes, Del	2,000

Contract (dated September 19, 1890) entered into with John Townsend.

Abstract of proposals for removal of the wreck of the scow Paddy Ryan, lying in Rancocas River, New Jersey, opened June 16, 1891, *by Maj. C. W. Raymond, Corps of Engineers.*

No.	Name and address of bidder.	Price.
1	American Dredging Company, Philadelphia, Pa	$485
2	Frank C. Somers, Camden, N. J	425
3	Delaware Construction Company, Wilmington, Del	1,200
4	Atlantic and Gulf Wrecking Company, Somers Point, N. J	499
5	Charles W. Johnston, Lewes, Del	365
6	Enoch Townsend, Linwood, N. J	345

Contract (dated June 24, 1891) entered into with Enoch Townsend. In progress.

G 13.

PRELIMINARY EXAMINATION OF SHARK RIVER, NEW JERSEY.

[Printed in House Ex. Doc. No. 25, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 24, 1890, from Maj. Charles W. Raymond, Corps of Engineers, giving results of preliminary examination of Shark River, New Jersey, made to comply with provisions of the river and harbor act approved September 19, 1890.

It is the opinion of Major Raymond and of Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, that Shark River is not worthy of improvement. The views of these officers are concurred in by me.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 24, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Shark River, New Jersey, in accordance with a provision of the river and harbor act of September 19, 1890.

This river discharges into the Atlantic Ocean about 20 miles south of Sandy Hook. It was examined and surveyed with a view to improvement in 1880, under the direction of the late Lieut. Col. N. Michler, Corps of Engineers, in accordance with a provision of the river and harbor act of June 14, 1880. The full reports of Colonel Michler and of his assistant, Mr. A. Doerflinger, who made the examination and survey, will be found in the Annual Report of the Chief of Engineers for 1881, Part I, page 730. Colonel Michler did not consider any work of improvement advisable.

From a personal examination of this locality I conclude that the physical conditions of the river do not differ essentially from those existing at the time of the survey in 1880, except that a long pile revetment has been constructed along the northern shore near the mouth, for the purpose of shore protection, and possibly with a view to future extension in order to form a new outlet and give the stream a more direct course to the sea.

The shifting character of the shores and bar at the mouth, the preponderating action of the flood current, which is constantly forming new shoals in the river, and the existence of two bridges without draws at a distance of less than a mile from the sea, indicate that the navigable conditions of the stream can not be essentially improved without expensive modifications and the construction of costly works of uncertain efficiency.

In his report above referred to, Mr. Doerflinger remarks as follows:

> As far as could be learned, the river at present is entirely without commerce, and no commercial or agricultural interests would be benefited even were the inlet in a condition to admit light-draft vessels to enter and pass out of the same. The river at present is available only for the use of fishing and pleasure boats during the warm season.

From the best information I have been able to obtain, I believe these remarks to be true at the present time.

For the reasons above stated, I am of the opinion that this river is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 25, 1890.

Respectfully submitted to the Chief of Engineers.

In my opinion, Shark River, New Jersey, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of November 24, 1890, and including the present and prospective demands of commerce.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 14.

PRELIMINARY EXAMINATION OF SOUND BETWEEN BARNEGAT BAY AND GREAT EGG HARBOR BAY, NEW JERSEY.

[Printed in House Ex. Doc. No. 42, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 2, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated October 20, 1890, from Maj. C. W. Raymond, Corps of Engineers, giving results of preliminary examination of sound between Barnegat Bay and Great Egg Harbor Bay, New Jersey, made to comply with provisions of the river and harbor act approved September 19, 1890.

Major Raymond reports that work at this locality would be of little or no benefit to commerce, and that, in his opinion, the sound is not worthy of improvement. Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, agrees with this opinion, and the views of these officers are concurred in by this office.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 20, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of the sound between Barnegat Bay and Great Egg Harbor Bay, New Jersey, in accordance with a provision of the river and harbor act of September 19, 1890.

As stated in my report of October 3, 1890, upon the thoroughfare from Cape May to the Great Bay north of Atlantic City, the southern portion of this sound, from Great Egg Harbor Bay to Great Bay, has been surveyed, and its proposed improvement is reported upon in the report referred to. The improvement contemplated is presumed to be the deepening of the water ways situated between the mainland and coast line, so as to form a continuous channel of convenient dimensions throughout the sound.

If such a channel were formed it would necessarily be narrow and circuitous, and therefore useless for sailing vessels. It would be probably of use principally to pleasure steamers plying between the numerous summer resorts in this vicinity. The mainland back of the projected channel is generally separated from it by extensive flats, so that the route would not connect points of production and consumption, and would be of little or no benefit to commerce.

A reliable estimate of the cost of the proposed improvement can not be made even approximately without an expensive survey, but it would doubtless be large. At some points the improvement would be of doubtful permanence.

For the reasons above given, I am of the opinion that this sound is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Third indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 24, 1890.

Respectfully returned to the Chief of Engineers.

In my opinion the sound between Barnegat Bay and Great Egg Harbor, New Jersey, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of October 20, 1890, and including the present and prospective demands of commerce.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 15.

PRELIMINARY EXAMINATION OF LITTLE EGG HARBOR BAY AND INLET, INCLUDING GREAT BAY, NEW JERSEY, WITH REFERENCE TO ESTABLISHING A HARBOR OF REFUGE.

[Printed in House Ex. Doc. No. 23, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated October 20, 1890, from Maj. C. W. Raymond, Corps of Engineers, giving results of preliminary examination of "Little Egg Harbor Bay and Inlet, including Great Bay, with reference to establishing a harbor of refuge," made to comply with provisions of the river and harbor act approved September 19, 1890.

Major Raymond reports that the harbor is not worthy of improvement, and Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, agrees that the locality should not be improved with reference to establishing a harbor of refuge. These views are concurred in by this office.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFCE,
Philadelphia, Pa., October 20, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon a preliminary examination of Little Egg Harbor Bay and Inlet, including Great Bay, New Jersey, with reference to establishing a harbor of refuge, in accordance with a provision of the river and harbor act of September 19, 1890.

The inlet to these bays is situated on the New Jersey coast about midway between Cape Henlopen and Sandy Hook. The bays are separated from the ocean by low beaches of shifting sand. Owing to the movement of the beaches, the low-water width of the inlet is constantly changing.

A harbor of refuge at this point would not be of use to vessels engaged in the foreign trade, since they do not pass in this vicinity. It would be only of service to the coastwise trade, which now employs vessels drawing 14 and 16 feet, with a constant tendency towards increase of draft. The depth of water in the channel and anchorages should therefore be not less than 20 feet.

The most frequent gales are from the northeast and the channel of entrance must have such a direction that a sailing vessel can enter and pass through it with a northeast wind. The course of the channel should therefore not fall to the southward of south-southeast. To form a suitable harbor under these conditions requires the construction of two jetties projecting from the beaches, one below the inlet and the other above. The problem is similar in character to that presented at Atlantic City and fully discussed by a Board of Engineers in a report dated May 31, 1887, which will be found in the Annual Report of the Chief of Engineers for 1887, page 815.

The minimum aggregate length of such jetties, to insure a reasonable probability of permanency to the improvement, is 25,000 feet. Following the methods of construction suggested by the Atlantic City Board, their cost would be more than $4,000,000. Owing to the shifting character of the beaches, expensive works of shore protection would undoubtedly be required, and if dredging were found necessary the cost would be still further increased.

The harbor thus formed would be lacking in accessibility, like all jetty harbors on sandy coasts, and the anchorages would be difficult to reach with a northeast wind. It is probable that such a harbor of refuge would increase the number of casualties instead of diminishing them, as has proved to be the case at the mouth of the Tyne.

Upon visiting this locality I learned that the idea is entertained that the inlet can be improved by the construction of a dike connecting the most southerly of the Seven Islands and Salt Island, thus forcing more of the backwater from Mullica River to pass through Shooting Thoroughfare, which is now the main channel. The effect of such a dike would, in my opinion, be principally produced on the thoroughfares south of the inlet, and it would have no appreciable effect upon the inlet or the shoals outside of it.

This inlet and the adjacent waters are used by only a few coasters of the smaller class. The local commerce is insignificant.

In brief, the construction of a harbor of refuge in this locality would be difficult and costly, the benefits resulting from it would be doubtful, and the commercial interests involved are small in value.

For these reasons I am of the opinion that the harbor is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. Raymond,
Major of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Third indorsement.]

U. S. Engineer Office,
Baltimore, Md., November 24, 1890.

Respectfully returned to the Chief of Engineers.

In my opinion, Little Egg Harbor Bay and Inlet, including Great Bay, New Jersey, with reference to establishing a harbor of refuge, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of October 20, 1890, and including the present and prospective demands of commerce.

Wm. P. Craighill,
Colonel, Corps of Engineers.

G 16.

PRELIMINARY EXAMINATION OF THE THOROUGHFARE FROM CAPE MAY TO THE GREAT BAY NORTH OF ATLANTIC CITY, NEW JERSEY.

[Printed in House Ex. Doc. No. 50, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated October 3, 1890, from Maj. C. W. Raymond, Corps of Engineers, giving results of preliminary examination of "Thoroughfare from Cape May to the Great Bay north of Atlantic City," made to comply with provisions of the river and harbor act approved September 19, 1890.

The thoroughfare is considered by Major Raymond and by Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, as not worthy of improvement, and I concur in the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 3, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of the thoroughfare from Cape May to the Great Bay north of Atlantic City, N. J., in accordance with a provision of the river and harbor act of September 19, 1890.

A preliminary examination of this locality was made in 1886 by Lieut. Col. H. M. Robert, Corps of Engineers, who was at that time the local engineer, and a report thereon was submitted to the Chief of Engineers under date of December 24, 1886. In 1887 an elaborate survey was made and a project for improvement was submitted by Colonel Robert under date of April 25, 1888. The report upon this survey and project will be found in House Ex. Doc. No. 306, Fiftieth Congress, first session, and also in the Annual Report of the Chief of Engineers for 1888, Part I, page 730.

In his preliminary report, Colonel Robert expresses the opinion "that the improvement is worthy to be made if it can be done for $100,000, but that it is not worthy to be made if its cost amounts to $250,000." In his project of April 25, 1888, he estimates the cost of the work at $200,000 if done by contract, or $130,000 if the Government builds its own plant and does the work by hired labor.

The coast frontage between Cape May and Great Bay consists of a salt-marsh meadow from 2 to 6 miles wide, lying between the mainland

and coast line, and traversed by numerous connecting water-ways. It is proposed to deepen these water ways by dredging so as to form a continuous channel 6 feet in depth and at least 50 feet wide at bottom from Cape May to Great Bay, a distance of about 65 miles.

The present and prospective demands of commerce stated in Colonel Robert's preliminary report are as follows:

> At present the commerce through this thoroughfare consists mainly of oysters and garden produce, the latter having for a market the neighboring seaside resorts, principally Atlantic City. The vessels used are small sail-boats, whose draft does not exceed 2 feet, and they can not cross the divides at low water. A 6-foot channel 75 feet wide would allow small steamers to be placed on the route, which doubtless would greatly increase the commerce seeking this route, and especially could it be used by pleasure steamers during the summer. The oyster trade would probably be greatly developed.

It appears, however, from the report of Mr. L. Y. Schermerhorn, assistant engineer, under whose supervision the survey was made, that the beds of the water ways along the route are of considerable value as oyster fisheries, and the improvement will necessarily interfere with and injure the private interests involved. It seems possible that the oyster trade might thus be injured in production by the improvement as much as it would be benefited in transportation. It appears that the transportation of garden produce will not be greatly facilitated, except between the terminal points, which are points of consumption and not of production, since the intermediate country is generally separated from the route by extensive flats. The channel would be too narrow and circuitous for the use of sailing vessels, and probably the improvement would be principally of use to pleasure steamers.

I know of no present or prospective demands of commerce other than those above mentioned; and I do not consider these sufficient to justify the expenditure involved. In my opinion the thoroughfare is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Corps of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., October 9, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer, it is considered that this locality is not worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 17.

PRELIMINARY EXAMINATION OF CAPE MAY CITY, NEW JERSEY, FOR BREAKWATER.

[Printed in House Ex. Doc. No. 89, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 2, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated November 1, 1890, from Maj. Chas. W. Raymond, Corps of Engineers, giving results of preliminary examination of Cape May City, for breakwater, New Jersey, made to comply with provisions of the river and harbor act approved September 19, 1890.

This locality is reported as not worthy of improvement by Major Raymond and by Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. I concur in the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 1, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Cape May City, N. J., for breakwater, in accordance with a provision of the river and harbor act of September 19, 1890.

Cape May City is situated on the New Jersey coast about 3 miles east of the extremity of Cape May. The shore is a long and shifting sand beach, completely unprotected from the winds and waves. From the best information I have been able to obtain, it appears to have been considered practicable to construct at this locality a breakwater in the open sea behind which vessels could obtain shelter from severe gales. McCries Shoal, which lies southeast from Cape May City and about 6½ miles from shore, was indicated as a possible location for such work.

The most violent gales and heaviest seas are from the northeast. The axis of the shoal lies in the same direction, and it is therefore not well located as a site for the proposed breakwater. Moreover, a comparison of charts made at long intervals show that the shoals is gradually wearing away; and, indeed, all the bottom in this vicinity is unstable. Under these circumstances, it is very doubtful whether the construction of a breakwater at this place capable of withstanding the attacks of the most violent storms is practically possible; but if possible, it would be at an enormous expense.

This locality is only about 14 miles from the Delaware Breakwater Harbor. Small coasters and occasionally empty colliers pass in the vicinity, but the commercial interests are insignificant, and would derive little benefit from the proposed work.

I am, therefore, of the opinion that this locality is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Third indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 24, 1890.

Respectfully returned to the Chief of Engineers.

In my opinion Cape May City, N. J., for breakwater, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of November 1, 1890, and including the present and prospective demands of commerce.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 18.

PRELIMINARY EXAMINATION OF PENSAUKEN CREEK, NEW JERSEY.

[Printed in House Ex. Doc. No. 81, Fifty-first Congress second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated October 30, 1890, from Maj. C. W. Raymond, Corps of Engineers, giving results of preliminary examination of Pensauken Creek, New Jersey, made to comply with provisions of the river and harbor act approved September 19, 1890.

Major Raymond reports that the advantages which might accrue from an improved channel would not, in his judgment, be proportionate to the cost of the improvement, and he is of the opinion, therefore, that Pensauken Creek is not worthy of improvement. Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, is of the same opinion. I concur in the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 30, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon a preliminary examination of Pensauken Creek, New Jersey, in accordance with a provision of the river and harbor act of September 19, 1890.

An examination of this creek was made in 1882, under the direction of Lieut. Col. G. Weitzel, Corps of Engineers, who reported that it was not worthy of improvement by the General Government, and that its improvement was not a work of public necessity. The report of this examination will be found in the Report of the Chief of Engineers for 1884, page 852.

In the reëxamination just made, the physical characteristics of the creek were found as previously reported. The stream between its mouth and the Forks, which is practically the head of navigation, covers a distance of about 6 miles, and is crossed by four bridges, all of which are without draws.

The lower bridge, which is a railroad crossing, is about 1½ miles above the mouth, and has an opening about 25 feet wide and 12 feet high at low water. The second bridge, which is about 500 feet above the former, is a highway crossing, and has an opening about 30 feet wide and 14 feet high. The third and fourth bridges are respectively about 2½ miles and 4 miles above the mouth. They are highway crossings and have openings about 60 feet wide and 12 feet high at low water.

About two-thirds of the length of the creek between the mouth and the Forks carries a less depth than 6 feet at mean low water, with a ruling depth of about 3 feet.

The shoal areas are generally covered with mud and sand, but at some points gravel and bowlder bars exist.

To provide a dredged channel 50 feet wide and 6 feet deep at mean low water, between the mouth and the Forks, would require the removal of about 150,000 cubic yards of material at a cost of $35,000 or $40,000. It is probable that works would also be required at the mouth to preserve the artificial channel at its junction with the Delaware River.

The commerce is now, as it was at the date of the previous examination of 1882, mainly confined to coal and stable manure moved up the creek, and molding sand, kaolin, and farm produce moved down the creek. The amount of this commerce does not seem to be large, and it is now carried mainly by scows and small boats, which are towed by a small tug, with smokestack arranged so that it can be lowered in passing under the bridges.

With the present commerce of the creek the permanent bridges do not seem to be marked obstructions. Of course, sailing vessels can not pass above the lower bridge, but the narrow and crooked character of the creek would practically render sailing vessels of small value, even though the present bridges were moved.

The extent of country tributary to the creek is small; the present railroad facilities for reaching the market are fair: and the advantages which might accrue from an improved channel would not in my judgment be proportionate to the cost of the improvement.

For these reasons I am of the opinion that the creek is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. Raymond,
Major of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Third indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 24, 1890.

Respectfully returned to the Chief of Engineers.

In my opinion Pensauken Creek, New Jersey, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of October 30, 1890, and including the present and prospective demands of commerce.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 19.

PRELIMINARY EXAMINATION OF THE WEST BRANCH OF THE SUSQUEHANNA RIVER, IN THE STATE OF PENNSYLVANIA, IN ORDER TO ASCERTAIN IF THE NAVIGATION OF SAID RIVER CAN BE MATERIALLY AND PERMANENTLY IMPROVED BY THE CONSTRUCTION OF EMBANKMENTS OR OTHERWISE; SUCH SURVEY ALSO TO BE MADE WITH A VIEW OF ASCERTAINING THE BEST PRACTICABLE METHOD OF CONFINING THE WATERS OF SAID RIVER, IN TIMES OF GREAT FLOOD, TO THE GENERAL COURSE OF ITS CHANNEL.

[Printed in House Ex. Doc. No. 136, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 29, 1890.

SIR: I have the honor to submit the accompanying copy of report dated December 20, 1890, by Maj. Chas. W. Raymond, Corps of Engineers, giving results of a preliminary examination of "the West Branch of the Susquehanna River, in the State of Pennsylvania, in order to ascertain if the navigation of said river can be materially and permanently improved by the construction of embankments or otherwise; such survey also to be made with a view of ascertaining the best practicable method of confining the waters of said river, in times of great flood, to the general course of its channel," made in compliance with the requirements of the river and harbor act approved September 19, 1890.

After careful investigation of the subject Major Raymond concludes that the navigation of the West Branch of the Susquehanna River can not be materially and permanently improved by the construction of embankments or otherwise, and that there is no practicable method of confining its waters, in times of great flood, to the general course of the channel which can now be undertaken. He is therefore of the opinion that the river is not worthy of improvement.

The Division Engineer, Col. William P. Craighill, Corps of Engineers, concurs in the opinion of Major Raymond, and the views of these officers meet with my approval.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 20, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon a preliminary examination of the West Branch of the Susquehanna River, in the State of Pennsylvania, in accordance with a provision of the river and harbor act of September 19, 1890.

The provision referred to directs an examination or survey "in order to ascertain if the navigation of said river can be materially and permanently improved by the construction of embankments or otherwise; such survey also to be made with a view of ascertaining the best practicable method of confining the waters of said river, in times of great flood, to the general course of its channel."

PHYSICAL CHARACTERISTICS OF THE WEST BRANCH.

The West Branch of the Susquehanna River begins in the northeast part of Clearfield County, Pa., and is formed by the junction of Clearfield and Moshannon creeks. From thence it flows northeasterly to Keating, where it receives the Sinnamahoning Creek. It then follows a general easterly direction to about the northern line of Northumberland County, where it turns south and unites with the North Branch at Sunbury. From this latter point it becomes the Susquehanna River, which discharges into Chesapeake Bay at Havre de Grace.

From the beginning of the West Branch to its junction with the North Branch at Sunbury, its length is about 125 miles; from Sunbury to its mouth is a further distance of about 125 miles.

The basin or watershed of the West Branch occupies the high table lands of the northern middle part of the State. The southern crest of the watershed, in the vicinity of the junction of the West and North branches, has an elevation of from 500 to 1,200 feet above the sea level, increasing to about 2,200 feet at its southwestern part; thence along its western side it maintains this latter elevation to its northern line, where in the northern part of the Pine Creek Basin it attains an elevation of over 2,600 feet; along the remainder of the northern crest the height quickly falls to about 1,200 feet, but rises again to about 2,000 feet along the eastern crest of the divide. The highest points in the State are along the crest of this watershed.

This basin or watershed has an area of nearly 6,900 square miles, about one-fourth of the drainage area of the Susquehanna River and its tributaries, or about one-seventh of the area of the State. It may be divided into the following minor basins, designated by the names of their principal streams:

Basin.	Area.	Basin.	Area.
	Sq. miles.		*Sq. miles.*
Clearfield	1,520	White Deer	460
Sinnamahoning	1,040	Loyalsock	520
Kettle	410	Muncy	240
Bald Eagle	950	Chillisaque	220
Pine	1,100		
Lycoming	410	Aggregate area of minor basins.	6,870

The limits of these basins are indicated upon the sketch herewith.*

The elevation of the Susquehanna River at the junction of the West and North branches is 430 feet above mid-sea level at Havre de Grace. The distance between these points is about 125 miles, hence the mean slope of the lower trunk of the river is nearly 3½ feet per mile. The slope is very variable for different parts of this distance, being over 5 feet per mile in the lower 40 miles, and about 2½ feet in the upper 40 miles.

Between Sunbury and the head of the West Branch the river has the following elevations and slopes:

Localities.	Distance.	Elevation above sea level.	Slope per mile.
	Miles.	*Feet.*	*Feet.*
Sunbury	0	430	....
Muncy	23	469	1.7
Williamsport	16	498	1.8
Jersey Shore	15	508	0.7
Lock Haven	13	550	3.2
Whetham	15	619	4.6
Keating	22	700	8.7
Head of West Branch	20	845	7.2

It is not to be assumed that the river slope between the points named is uniform, these points being taken simply because the levels of the State Geological Survey give the elevation of the above localities.

The slope of the main affluents for which levels are obtainable are about as follows:

	Feet per mile.
Clearfield Basin	14 to 20
Sinnamahoning Basin	7 to 19
Bald Eagle Basin	12 to 18
Pine Basin	9 to 20
Lycoming Basin	12 to 20

The extreme low-water stage of the river usually occurs in the months of August and September, when the minimum discharge is liable to fall to about 800 cubic feet per second at Williamsport, and to about 1,100 cubic feet at the mouth of the West Branch. The mean low-water discharge at the points named is about double the above quantities, or about 0.28 of a cubic foot per second per square mile of drainage basin.

The water power of the main river and its tributaries is utilized, according to the census of 1880, by about 480 mills of various kinds. Between Lock Haven and the mouth of the West Branch, the left bank of the stream is occupied by the west branch of the Pennsylvania Canal. The heights of the dams across this part of the river are as follows: Lock Haven, 11 feet; Williamsport, 10 feet; Muncy, 7 feet; Lewisburg, 3 feet, and Sunbury, 8 feet.

NAVIGATION OF THE RIVER.

At the present time the West Branch of the Susquehanna River is not used for the purposes of navigation, and is not navigable at its ordinary stages. At these stages its slope and volume preclude the possibility of obtaining a channel of navigable depth by the construction of embankments or by canalization. The permanent improvement of the channel for the purposes of navigation could probably only be accomplished by means of locks and dams. The magnitude and cost of such a method of improvement may be inferred from the statement that the difference in elevation between the mouth and head of the West Branch, covering a distance of about 125 miles, is over 400 feet.

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*Not reprinted.

Such an improvement would be of little value unless it was continued to the mouth of the river at Havre de Grace. This part of the river, below the junction of the West Branch, has a length of about 125 miles, with a fall of 430 feet. It is not navigable at ordinary stages and its slope and volume would render locks and dams necessary for its improvement. The cost of such an improvement, over a distance of 250 miles, and an elevation of more than 800 feet, would be very great, and would only be justified by commercial necessities which do not now exist. There are at present sufficient transportation facilities, both by rail and canal, between the mouth of the river and Williamsport.

In view of these considerations, I am of the opinion that a survey is not necessary to ascertain whether the navigation of the West Branch of the Susquehanna River can be materially and permanently improved.

FLOODS OF THE RIVER.

The great floods of which the heights have been recorded are those of 1865 and 1889. These heights are exhibited in the following table:

Locality.	Distance from mouth.	Elevation above ordinary low water.	
		March, 1865.	June, 1889.
	Miles.	*Feet.*	*Feet.*
Mouth of West Branch	0		
Northumberland	8	20	18
Muncy Dam	31	30	37
Williamsport	49	27	33½
Lock Haven	75	14	18
Clearfield		10	17

The flood of 1865 was caused by the rapid passing away of a large accumulation of snow and ice after a severe winter, and its amplitude was probably increased by ice gorges.

The flood of 1889 exceeded all preceding flood limits and was due to the heavy rainfall of May 30 to June 1. Although the storm was widespread, extending from Kansas to the Atlantic coast, the heaviest rainfall was confined to a belt about 150 miles in width, extending across the middle of Pennsylvania, with its axis slightly east of north. Within this belt from 4 to 9 inches of rain fell during the thirty-six hours' duration of the storm. The heaviest precipitation was upon the high table lands of the watershed of the West Branch of the Susquehanna.

The monetary extent of the injuries arising from the flood is not known, and under date of June 23, 1890, the secretary of the Flood Relief Commission states that no attempt has been "made * * * to secure even an approximate estimate of the loss." In the valley of the West Branch the heaviest losses probably occurred in Clinton and Lycoming Counties, since they contained the largest centers of population. The principal parts of the cities of Lock Haven and Williamsport were inundated to a depth of from 4 to 8 feet. The loss of life in the counties bordering on the West Branch was 78, and the disbursements of the Flood Relief Commission to the sufferers within this district aggregated nearly $300,000.

Large sections of the canal were completely destroyed; bridges, sawmills, lumber yards, logs, fences, barns, and live stock were swept away; and in places once fertile farms and bottom lands were covered with sand and gravel.

The following table contains data relating to the storm within the limits of the West Branch, or in proximity thereto:

Locality.	Storm began.	Storm ended.	Duration.	Rainfall.
			Hrs.	*Ins.*
Siglerville, Mifflin County	3 p. m. May 30	1 a. m. June 1	34	......
Hollidaysburg, Blair County	....do	3 a. m. June 1	36	6.10
State College, Centre County	3:30 p. m. May 30	5 a. m. June 1	37	5.04
Lewistown, Mifflin County	4 p. m. May 30	2 a. m. June 1	34	......
Huntingdon, Huntingdon County	....do	....do	34	7.50
Philipsburg, Centre County	....do	3 a. m. June 1	35	6.09
Grampian Hills, Clearfield County	4:30 p. m. May 30	11:30 p. m. May 31	32	8.60
Emporium, Cameron County	5 p. m. May 30	11 p. m. May 31	32	5.97
Coudersport, Potter County	6 p. m. May 30	12 p. m. May 31	30	5.40
Selin Grove, Snyder County	....do	3 a. m. June 1	33	7.53
Charlesville, Bedford County	8 p. m. May 30	3 p. m. May 31	36	7.60
Williamsport, Lycoming County	9 p. m. May 30	5 a. m. June 1	32	......
Ralston, Lycoming County	1 a. m. May 31	12 m. June 1	32	......
Muncy, Lycoming County	3 a. m. May 31	1 p. m. June 1	34	......

So far as relates to the basin of the West Branch of the Susquehanna, the storm began about the middle of the southern line of the watershed, and in about 11 hours it had extended across the basin to its northeastern limits. The average duration of the rainfall was about 34 hours, and its mean depth for the above points was 6.65 inches.

The following information, furnished by Mr. T. T. Wierman, jr., chief engineer of the Pennsylvania Canal, will give some idea of the rate of progress and rise of the flood:

Locality.	Distance.	Time of highest flood.	Height.
	Miles.		*Feet.*
Lock Haven Dam	0	June 1, 4 p. m	18
Williamsport	26	June 2, 1 a. m	33½
Muncy Dam	44	....do	37
Northumberland	67	June 2, 9 a. m	18

The area of the watershed above Lock Haven is about 3,000 square miles, or nearly one-half the area of the entire basin. The watershed discharging at Williamsport is about 4,500 square miles; at Muncy Dam, about 6,000 square miles; and at Northumberland, 6,800 square miles.

It will be seen from the foregoing tables that the storm in the southwestern, western, and northwestern parts of the basin began about 5 p. m. May 30, and at 4 p. m. June 1, or 47 hours thereafter, the flood had attained its maximum height at Lock Haven. This maximum was reached about 28 hours after the cessation of the storm in the western limits, and 4 hours after its cessation in the eastern limits of the basin. On June 5 the principal volume of the flood had passed away and the river had fallen nearly to the plane of common high water.

In a mountainous country, such as forms the watershed of the West Branch of the Susquehanna, it may be assumed that at least 50 per cent. of an ordinary rainfall reaches promptly the recipient of the basin. The rate of infiltration and absorption of rainfall will, upon the same area, be quite constant, consequently the percentage of loss by infiltration must be less in excessive than in ordinary precipitation.

In such a rainfall as caused the flood of 1889, where the precipitation was over 6 inches in 34 hours, or from four to five times greater than the quantity which falls in an ordinarily heavy rain, it is probable that 75 per cent. of the rainfall may reach the outlet of the basin.

The area of the watershed of the West Branch of the Susquehanna is about 6,900 square miles. The average rainfall upon the basin between May 30 and June 1, 1890, was over 6 inches. Upon the assumption that 75 per cent. of this rainfall reached the outlet of the basin, the aggregate discharge was 72,135,360,000 cubic feet.

No observations are available to determine the discharge of the lower trunk of the West Branch during any period of the flood, but it may be of interest to compare its probable flood stage with the low water stage of the river.

From information obtained from volume 16, page 587, Tenth Census of the United States, and from Mr. T. T. Wierman, jr., chief engineer of the Pennsylvania Canal Company, the low-water discharge of the West Branch may be assumed at 1,000 cubic feet per second, or 86,400,000 cubic feet per day. It has been previously determined that the discharge of the river during the continuance of the flood was about 72,135,000,000 cubic feet, and since the estimates of various observers assign about 1 week for the flood stage of the river, the mean daily discharge during this interval was about 10,300,000,000 cubic feet per day, or about one hundred and twenty times the low-water discharge of the river. How much the maximum discharge during the flood period exceeded the mean can not be determined.

It is possible to apply an approximate check to this estimate of the probable flood discharge in the following manner: By the gauging of the flood discharges of rivers, the following empirical formula for discharge has been established: $Y=M\sqrt{A}$; in which Y represents the number of cubic yards of discharge per second; M, a constant depending upon the character of the watershed, and A, the area of watershed in square miles. For the main part of the Mississippi River, $M=49.3$; for the Ohio River at its mouth, $M=56$, and for the Ohio River at Wheeling, $M=57$. The watershed of the West Branch is not dissimilar from that of the Ohio River at Wheeling, and if this value of $M=57$ be accepted for the West Branch and substituted in the above equation, there will result the following:

$$\frac{2,671,680,000}{86,400\ T}=57\sqrt{6870}, \text{ or } T=6.5 \text{ days.}$$

This interval of 6½ days practically agrees with the previously mentioned week's duration of the flood.

CAUSES WHICH INCREASE THE DESTRUCTIVE EFFECT OF FLOODS.

Such causes may be considered under the three following heads:

(1) Destruction of forests and cultivation of land.
(2) Artificial constructions, such as bridges and dams.
(3) Collection of logs, lumber, and ice in the stream and upon its banks.

(1) *The destruction of the forests* from the mountain crests and slopes of a watershed is undoubtedly the principal cause of the increase of the average magnitude of floods.* The evidence collected during the last

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* The following information with reference to the deforesting of the watershed of the West Branch of the Susquehanna was received after the completion of this report:

Lumbering operations were commenced in this region in 1850, but no systematic record of the amounts cut was kept until 1862. In the latter year the cut was

25 years establishing this conclusion is well-nigh overwhelming, and it is verified by repeated observations, not only in the mountainous countries of Europe, but also in our own land. By the removal of the forests from the mountain slopes the ground is robbed of its protecting covering of roots, moss, leaves, and porous soil, which forms the forest floor and serves as a natural storage reservoir, holding back the water of rainfall and melting snow, and compelling it to descend slowly to the channels. By the subsequent cultivation of the lands, ditches and drains are made to facilitate the more rapid discharge from the cultivated surfaces, until the rain rushes down the hillsides in destructive torrents, gullying the ground and choking the minor lines of drainage with rocks, sand, and gravel, and hurrying into the recipient of the watershed volumes of water which before reached it in a comparatively quiet flow.

Colonel Torrelli affirms as the result of careful observation that four-fifths of the precipitation in forests is absorbed by the soil or detained by the surface of the ground, to be gradually given up in springs and gentle rills, and only one-fifth of the precipitation is delivered to the rivers rapidly enough to create floods. Upon the same slopes and surfaces denuded of their forests, the proportions are reversed.

That the destruction of the forests in mountainous watersheds is followed by disastrous floods where previously such floods were unknown is not a matter of theory, opinion, or probability, but it is a well-established physical fact.

(2) *Artificial constructions, such as bridges and dams.*—Bridges materially interfere with the free flood discharge of rivers by a reduction of cross-section from abutments and piers, especially since from motives of economy in construction they are generally placed where the natural width between the banks is abnormally small.

When the banks are but little above the ordinary flood line the approach to the bridge is frequently upon an embankment or causeway raised considerably above the adjacent bottom lands, and such embankment acts during floods as a partial dam at points where the section of discharge is already seriously impaired by abutments and piers in addition to a naturally reduced width.

The experience of 1889 upon the West Branch indicates that the bridge structures themselves were placed at such an insufficient height that the drift and wreckage of the flood became massed against the structures until the accumulated material formed temporary dams, behind which the amplitude of the flood was increased and held until the pressure tore away the barrier and hurled upon the already flooded district below a rushing wave of water, logs, trees, and timber. The destruction of successive bridges was a noticeable feature of the flood of 1889.

It is manifest that an added source of destruction is involved in this irregular holding back of the flood discharge only to loose it again in a form beyond control.

(3) *Collection of logs, lumber, and ice in the stream and upon its banks.*—As long as logs are run and boomed in rivers, and lumber is stored in large quantities upon areas liable to overflow, the danger will exist which arises from the presence of such material in the flood discharge

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38,000,000 feet B. M. It rapidly increased until it attained its maximum of 319,000,000 feet in 1873, and then fell to about 212,000,000 feet in 1890. The total amount cut since 1862 is about 5,250,000,000 feet B. M., which represents about 30,100,000 logs.

In the year 1880 the timber on nearly 700,000 acres of land in Pennsylvania was destroyed by fire.

The above statements are based on the census report for 1880, and on information furnished by Mr. George S. Banger, secretary of the Susquehanna Boom Company.

of a river. When the available water way at bridges or other narrowed sections is taxed to its utmost capacity, the admixture of logs and lumber with the flood is sure to result in the formation of a jam.

With floating trees and drift eliminated from the flood, and ample provision at bridge sites for as unrestricted a flow as possible, the danger from floating logs and lumber will be reduced, but can not be entirely removed.

If floods occur at a time when the stream is filled with heavy ice, no possible provision can remove the contingency of ice gorges and the danger and injury incident thereto. All that can be done is to remove as far as possible the causes which may arrest the free movement of the ice. Even after this has been done there will still remain possibilities of disaster which can not be provided for or averted.

PROTECTION AGAINST FLOODS.

The immediate cause of inundations is the flow of water into the beds of rivers faster than the channels are capable of discharging it. Hence all methods of protection against floods must be directed either to the regulation or diminution of the rate of inflow or to the control or increase of the rate of outflow. The former have been classified as methods of prevention, and the latter as methods of control.

Destructive inundations are seldom produced by precipitation within the limits of the main valley, but almost always arise from the rapid release of water from the upper areas and slopes of the watershed. Any method which checks the flow of surface water into the channels of the affluents or retards its delivery into the main recipients will diminish the danger of floods. The methods of prevention include such devices as aim to hold back the rapid discharge of water from the lines of drainage, thereby reducing the maximum discharge and consequently the height of the flood by giving the main recipients of the watershed a longer time in which to discharge the rainfall. The methods of control include such devices as hold the flood volumes within prescribed barriers without any effort to limit the maximum volume of the flood, regulate the discharge of the tributaries, or remove obstructions to the free flow of the stream.

The methods of prevention may be summarized as follows: (1) Maintenance and planting of forests at the headwaters and upon the upper slopes of the basin, (2) storage reservoirs, and (3) transverse barriers carried across the lines of drainage, which will moderately store or check the passage of the flood volumes and hold in the ravines the materials detached by scour. The methods of control are as follows: (1) Longitudinal embankments to retain the flood volume as nearly as possible within the limits of the natural channel. (2) Barriers constructed at rocky gorges on the larger tributaries to reduce the widths of the streams so as to regulate the times of arrival of their floods in the main channel. (3) Increase of the dimensions of the channel. (4) Removal of the causes of temporary obstructions. In general, the conditions surrounding different localities will demand different treatment, and in many cases two or more of the foregoing methods might with advantage be applied to different parts of the same stream.

The method of prevention by the maintenance and planting of forests upon the headwaters and upper slopes of the affluents of the basin depends for its efficiency upon the ability of forest-covered slopes to retain for a considerable time a large percentage of heavy rainfall, thereby preventing the surcharge of the lines of drainage. In France, Italy, Germany, and Austria the systematic planting of mountain slopes, as a means of restoring lost fertility and preventing the inundations following the destruction of forests, is an established fact followed by results more satifactory than the most sanguine anticipations.

The method of prevention by storage reservoirs depends for its efficiency upon the ability of the basin to furnish large areas which can be flooded with small injury by dams built across the lower end of the impounding area. To render such dams possible at reasonable cost requires that they should be founded upon rock or other impermeable strata; that the reservoirs at the sites of the dams should reduce from broad areas to narrow gorges, and that the area of the flooded basin should be large enough to keep the height of the dams within safe limits.

Such dams could not be utilized for water-powers, since their efficiency as flood-storage reservoirs depends upon their being empty, except during flood stages of the river.

The third method of flood prevention, by transverse barriers carried across the lines of drainage, depends for its efficiency upon the application of constructions at a very large number of points upon the tributaries of the main recipient, whereby their waters are delayed in reaching the main trunk of the basin.

Upon the minor lines of drainage the barriers consist of rough piles of rocks or bowlders placed at frequent intervals across the beds of the torrents; upon larger streams they become permeable rock dams built wholly or partly across the stream, and rustic dams formed of timber and brush are also used. Some idea of the extent to which this sort of improvement has been carried in Europe may be formed from the statement that in the valley of the Ubaye, in the Maritime Alps, which has an area of 400 square miles, 71 main dams and 2,916 rustic dams have been built, the total cost of the works up to December 31, 1887, being about $553,000. An interesting account of the details of these works, contributed by Capt. F. A. Mahan, Corps of Engineers, will be found in the Engineering Record of December 6, 1890.

The method of controlling the action of floods by longitudinal embankments or levees, by which the floods are confined more or less to the bed of the stream, is at once the oldest and most common means of protection. Such embankments usually consist of earth of a suitable character to resist the rapid percolation of water, with side slopes sufficiently flat to secure the stability of the embankment, and with their tops carried to a small height above the flood plane.

Where affluents enter the main stream the embankments must be carried far enough up the secondary valleys to reach ground above the flood levels. Infiltration, drainage, and town sewage from areas behind the dikes must be removed during flood stages of the river by discharging through sluices or, if necessary, by pumping.

Where the linear extent of the land bordering a river and requiring protection from floods is large, the cost of such embankments is great both for construction and maintenance. Experience has demonstrated that no amount of care can secure them from occasional rupture, and in such cases the injury from the inundation may be more serious than the effect of the natural flood. No absolute knowledge of the height of future floods is possible, hence no ordinary height of embankment can offer absolute safety. In rivers where heavy ice may form during the winter season the danger of inundation from ice gorges is always possible, and it is manifest that where embankments exist the danger from this cause is greatly increased.

In streams carrying large quantities of sand and gravel during their flood stages a filling up of the river bed may ensue, necessitating a corresponding raising of the height of the banks, a process which may continue until the bed of the stream is raised even above the level of the adjacent land. This result is said to have followed the embankment of some of the rivers in Italy, and in Japan it is stated that upon rivers for a long time so protected the bed has been raised to a height of 30 or 40 feet above the level of the adjacent plain.

Unless inundations occur at short intervals, and during seasons when great injury would result to crops, the systematic exclusion of all floods by longitudinal embankments has been considered of doubtful advantage.

The general policy in France now seems to be where land is of small value to provide low embankments which will diminish the frequency of common freshets; as land becomes more valuable the extent and height of the dikes is increased. At towns and other centers of population where inundation involves great disaster, it would be necessary to provide embankments unsubmergeable by any possible flood.

It is evident that embankments must tend to increase the height of floods, and consequently the tops of such works as are intended to be unsubmergeable must be carried to a height considerably above the range of any known flood at their locality.

Barriers at rocky gorges to regulate the times of arrival of tributary floods in the main channel can only be employed under favorable and rare conditions.

The barriers above Roanne upon the upper Loire, at Pinay and La Roche, are of the latter character. In the floods of 1846 and 1856 they held back for five days the water which otherwise would have passed through the valley in two days, and by this action averted disastrous inundations Their efficiency was such that Napoleon III advocated the extension of the principle to the smaller affluents of the Loire.

The peculiar circumstances which render this improvement successful are worthy of attention. The Loire proper is formed by the union of the Allier and the Upper Loire, upon which the dikes are situated, and the combination of their floods is the principal cause of inundations. These streams do not experience simultaneous floods when the mountain chain separating them receives the rainfall on its two slopes, for the Allier and its affluents are shorter and have steeper slopes than the Loire and its affluents, so their floods pass the point of junction before the arrival of the flood of the Upper Loire. The dikes still further check the descending waters of the Loire and thus diminish the elevation of the floods below.

The complete control of great floods by increasing the dimensions of the natural channel, and by removing or preventing the formation of obstructions to the flow of the stream, is generally impossible, yet undoubtedly much can be accomplished in this way to diminish the injurious effects of floods. If the channel is narrowed by rocks or permanent shoals they should be removed. Trees liable to be uprooted by floods should be cut down; drift piles on the shores and islands should be burned, and bridges should cross the rivers at such points, and with such heights and spans, as to reduce to a minimum their interference with the free discharge of the flood volume.

METHODS APPLICABLE TO THE WEST BRANCH OF THE SUSQUEHANNA.

The growing interests of agriculture and commerce involve arrangements which necessarily increase the danger and range of floods, and it is not easy to place these arrangements under an efficient control. It is desirable, therefore, to consider whether the disastrous effects of inundations can be modified by methods which do not interfere with these interests.

It seems evident that the method of prevention by storage reservoirs is not applicable to the case of the West Branch. The rapid slopes of the valleys of the affluents along their longitudinal axis would generally prevent the possibility of flooding large areas by dams of reasonable heights; the torrential character of the affluents would soon reduce the capacity of the reservoirs by filling them with sand and gravel, and the impounded water would be a standing menace to the country below from the danger of bursting its barriers. Even if a few locations were found where dams of moderate height would suffice, the land is too valuable for agricultural purposes to be appropriated for such objects.

An approximate idea of the necessary extent of storage basins for the control of the West Branch may be formed from the statement that to hold back one-half the volume of the flood of 1889 from the lower trunk of the river would have required 65 square miles of storage basins, filled to an average depth of 20 feet. This would have necessitated dams considerably over 20 feet in height.

The method of control by transverse barriers to check the flow in the larger tributaries is also inapplicable to this case, as will readily be seen by reference to the accompanying sketch. This method involves the regulation of the times of arrival of the floods of the tributaries in the main stream, and can only be employed when the flood elevations are controlled by the waters of a very small number of tributaries whose valleys are near each other, so that their floods are due to the same meteorological causes, as is the case on the Loire. The floods of the West Branch result from the coincidence of floods from many affluents, distributed throughout the whole extent of its valley. It might be considered theoretically possible to control the times of the component floods for a given set of constant meteorological conditions; but in an extended valley these conditions are ever varying, and a solution adapted to the peculiarities of one great storm would be without value in another.

For example, the storm of June, 1889, as before stated, commenced at the southwest corner of the basin and crossed the watershed, arriving at its northeast corner in about 11 hours. Thus the tributaries near the head waters received their flood volumes before those on the lower part of the river. Had the direction of the storm been reversed the relation between the times of arrival of the tributary floods in the main channel would have been entirely different and the result would have been a much smaller flood elevation.

The control of the floods of the West Branch by longitudinal embankments or levees is impracticable on account of the magnitude of the flood elevation, which would require embankments of great height unless they were located far from the river banks, where they would not protect the valley. The data is not at hand for even a rough approximation of the height of embankments necessary to protect Williamsport from inundation in 1889. We only know that the height of the uncontrolled flood was 33⅓ feet above the low-water stage of the river and that it would have risen to a much greater height had it been confined.

Similar considerations show the impracticability of any adequate relief from increasing the dimensions of the channel.

All that can be done at present to protect the valley of the West

Branch of the Susquehanna from inundations seems to be to remove, so far as possible, the conditions tending to increase the destructive effects of floods. Obstruction by bridges and boom piers should be reduced to a minimum; leaning trees and drift should be removed from the banks; logs and lumber should be prevented from mingling with the flood discharge; and, most important of all, such forests as yet remain upon areas not valuable for cultivation, especially near the headwaters and on the upper slopes of the basin, should be protected.

As the population becomes more dense the injuries from uncontrolled floods will increase; and the time must arrive in this country, as it has already in France, Germany, and Italy, when the execution of a thorough scheme of control will be demanded. This will require the systematic construction of numerous low dams and other inexpensive works to restrain the flow of the more remote tributaries, so as to give the lower valley all possible time for the discharge of the flood volume, and new forests must be planted and maintained. The application of these remedies may reduce the heights of floods so materially that they will pass from dangers to inconveniences, and embankments of moderate heights may then suffice for the complete exclusion of the flood waters from the towns and cities of the lower valley.

The improvements suggested are so purely local in character and involve so many local interests that they probably never can be undertaken by the General Government. For the preparation of projects and the conduct of the work accurate and detailed surveys will be required. These will doubtless be made in due time under State authority. No survey, however, is necessary to determine that the navigation of the river can not be materially and permanently improved by the construction of embankments or otherwise, or to show that there is no practicable method of confining its waters in times of great flood to the general course of the channel which can now be undertaken.

In view of the above facts and reasons I am of the opinion that this river is not worthy of improvement.

Very respectfully, your obedient servant,

C. W. Raymond,
Major, Corps of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. Engineer Office,
Baltimore, Md., December 24, 1890.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of the local engineer of December 20, 1890, and having in view the present and prospective demands of commerce, I have to state, as required by section 18 of the river and harbor act of September 19, 1890, that in my opinion the West Branch of the Susquehanna River in the State of Pennsylvania is not worthy of improvement.

Wm. P. Craighill,
Colonel, Corps of Engineers.

G 20.

PRELIMINARY EXAMINATION OF TOMS RIVER, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report of a preliminary examination of Toms River, New Jersey, in accordance with a provision of the river and harbor act of September 19, 1890.

This river enters Barnegat Bay at a distance of about 11 miles north of Barnegat Inlet. The village of Toms River, which has a population of about 1,500, is situated on the north shore, at the head of navigation, at a distance of about 5 miles from the bay. The village of Island Heights, which is principally a summer resort, is situated on the same shore about 2½ miles below.

The principal commerce is at the village of Toms River. Large quantities of clams, oysters, fish, salt hay, and lumber are brought to this place by water and from thence distributed to the surrounding country. Wood for fuel and bricks is shipped in vessels from here to New York and other points. In former times, before the shoaling of the channel, vessels were built here for the coasting trade. Up to the present time I have been unable to obtain reliable estimates of the amounts of the materials transported.

At the mouth of the river there is a rather narrow channel over the bar, having a depth of about 5 feet at mean low water. From thence to a point about half a mile below the village of Toms River there is a channel of sufficient depth, and the drawbridge which crosses the river at Island Heights does not appear to be an obstruction to navigation. In the channel along the water front of the town, and extending about half a mile below, there is now a low-water depth of from 2 to 3 feet, where I am informed there was formerly a depth of about 7 feet.

The tide rises at the mouth of the river about 2 feet, and at the head of navigation about 15 inches. The water rises in freshets from 2 to 3 feet. The shoaling is principally due to material brought down in suspension by the stream from above. The water flows rapidly through the channel, contracted by two bridges above the town and, spreading out, deposits its load below.

If a channel of moderate width and depth were dredged through this obstructed reach of half a mile it would be undoubtedly of considerable benefit to the commerce of the river, some of which is of a non-local character. The cost and probable permanency of such an improvement can only be determined by a survey. From my examination I infer that the cost would not exceed about $7,000. Since the currents are of low velocity and the fall of the river is small the rate of shoaling is probably very slow, and a reasonable degree of permanency may be expected.

The cost of a survey is estimated at $150, which can be provided from the amount allotted to this office for preliminary examinations.

In my opinion the river is worthy of improvement.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons given by the local engineer, it is considered that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

SURVEY OF TOMS RIVER, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., June 30, 1891.

GENERAL: I have the honor to submit the following report upon the survey of Toms River, New Jersey:

The preliminary examination of this river, provided for by the river and harbor act of September 19, 1890, was made in the fall of 1890, and the report thereon was transmitted under date of November 19, 1890.

By this examination it was developed that the desired improvement is limited to about half a mile of the river directly below the bridge across the stream at the village of Toms River, whereby a channel of moderate depth and width can be obtained through the shoal areas between the wharves near the bridge and the unobstructed channel below. It was thought that such a channel would be reasonably permanent and could be obtained, by dredging, for about $7,000.

In view of these facts I reported that in my opinion Toms River was worthy of improvement to the extent above indicated, and recommended, for the purpose of obtaining the necessary data for a definite location of the channel and estimate of costs, that a survey be made at a cost not to exceed $150. This recommendation was approved and the desired allotment made on November 22, 1890. The survey was accomplished in June, 1891.

The results of the survey may be summarized as follows:

From the upper end of the wharves at the bridge to a point about 1,500 feet below, the channel giving access to the wharves on the south side of the river carries a depth of from 2 to 3 feet at mean low water; from thence to the 6-foot curve the distance is about 2,000 feet further, making the total length of channel requiring improvement about 3,500 feet. Along the north side of the stream for a distance of about 700 feet, directly below the bridge, there is a channel about 50 feet wide and from 3 to 4 feet deep, which, in its unimproved condition, fulfills all requirements for that part of the stream.

The remaining part of the river to its mouth carries a depth of about 6 feet at mean low water. In Barnegat Bay, into which Toms River discharges, slightly less than 6 feet can be carried. Between the bridge at the village of Toms River and the outlet from Barnegat Bay into the ocean, there are two railroad bridges across the channel, but these bridges are provided with draws of ample width for all passing commerce.

The ordinary range of the tide in the upper reach of Toms River is from 1 to 2 feet; the material which constitutes the bed of this part of the river is sand and mud.

The improvement which is recommended is the formation by dredging of a channel 75 feet wide and 6 feet deep at mean low water from the 6-foot curve to the bridge at the village of Toms River, or for a distance of about 3,500 feet. Such a channel is shown on the accompanying map, and requires for its formation the removal of 35,000 cubic yards of material, scow measurement, at an estimated cost of $10,000. To do this work it will be necessary to bring a dredge from a distance, which will add considerably to the expense. The estimated cost is based upon the assumption that the necessary sum will be made available in one appropriation, so that the dredge will have to make but one trip to and from Toms River.

A tracing covering that part of the river for which improvement is recommended is transmitted in a separate package.

Although an effort has been made to obtain commercial statistics, none have yet been received.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., July 9, 1891.

Respectfully submitted to the Chief of Engineers and recommended for favorable consideration.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

G 21.

PRELIMINARY EXAMINATION OF GOSHEN CREEK, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 25, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon a preliminary examination of Goshen Creek, New Jersey, in accordance with a provision of the river and harbor act of September 19, 1890:

This creek rises in the central part of Cape May County and discharges into Delaware Bay about 15 miles north of Cape May. The stream can be ascended at low water in a small boat to a point about 4 miles from the mouth, and over this distance it flows through salt marshes which are but little above the level of high tide.

The village of Goshen is situated about half a mile from Goshen Landing, which is on the creek about 1¼ miles above the mouth. Through this distance, the only part of the creek for which improvement is desired, the width is from 20 to 30 feet and the depth from 4 to 6 feet at

mean low water. The range of the tide, both at the mouth and at Goshen Landing, is about 5 feet.

In the vicinity of the mouth of the creek Delaware Bay is covered by soft mud flats, extending 2 or 3 miles outside the shore line, forming, from their protected position, a favorite anchorage for small coasters. At the mouth this soft mud bottom is covered to a depth of 2 or 3 feet with sand from the adjacent beach, reducing the low-water depth to less than 1 foot in this locality.

Previous to 1880 the soft mud bottom of the bay extended into the mouth of the creek, and the depth of water was sufficient. There was then a minimum width of 30 feet between the sod banks below Goshen Landing. During a severe storm in 1880 the mouth of the creek was closed by the advance of the sand beach from the south, and the partly closed mouth has so obstructed the tidal flow that the meadow banks have materially encroached upon the width of the stream.

About twenty-five vessels of from 10 to 50 tons burden sail from Goshen Creek, and are engaged in a trade covering farm produce, coal, oysters, wood, and lumber. In former times, considerable ship-building was carried on in the creek, and during the 50 years preceding 1880, it is stated that from two to three vessels of from 300 to 400 tons measurement were annually built. Since the obstruction of the mouth in 1880 this industry has ceased.

An excellent farming country is tributary to the commerce of the creek. The railroad is from 2 to 5 miles distant from this tributary area, and the removal of the obstructions to navigation from the stream would doubtless increase its commerce.

The improvement desired is the widening of the creek by dredging so as to obtain a minimum width of 30 feet between the mouth and Goshen Landing, and the formation of a channel with a low-water depth of about 3 feet through the bar at the mouth out to the soft mud bottom beyond. This would practically restore the creek to its navigable condition previous to the storm of 1880.

The widening of the creek would require the dredging of about 15,000 cubic yards of material, which could be cast over upon the adjacent meadow. The improvement of the bar at the mouth would require the construction of two sand-tight pile jetties, protecting a channel about 50 feet wide and extending about 500 feet beyond the shore line. The cost of the work indicated is estimated approximately at from $12,000 to $14,000. The improvement would probably be permanent.

For the reasons above stated I am of the opinion that this creek is worthy of improvement.

For the formation of a definite plan and estimate a survey of the creek from the mouth to Goshen Landing is necessary. This survey will cost about $300. The sum of $167 from the allotment to this office from the appropriation for examinations, surveys, and contingencies of rivers and harbors, for preliminary examinations, is available for this work, and a further allotment of $133 will be required.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., Nov. 26, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons given by the local engineer it is considered that Goshen Creek, New Jersey, is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

SURVEY OF GOSHEN CREEK, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., June 26, 1891.

GENERAL: I have the honor to submit the following report upon the survey of Goshen Creek, New Jersey.

The examination of this creek, provided for by the act of September 19, 1890, was made in the fall of 1890, and the report thereon transmitted under date of November 25, 1890. By this examination it was found that the desired improvement was limited to about 1¼ miles of the creek below Goshen Landing and the improvement of the bar at the mouth, whereby a minimum width of 30 feet would be obtained between the low-water lines in the narrow parts of the creek, and the formation of a channel about 3 feet deep at mean low water through the sand bar at the mouth, and extending out to the soft mud bottom beyond.

It was further shown that the present commerce of about 25 small vessels was engaged in the navigation of the creek; and that this commerce would be materially increased by the removal of existing obstructions which could probably be accomplished for about $12,000 or $14,000.

In view of these facts I reported that in my opinion Goshen Creek was worthy of improvement and recommended, for the purpose of obtaining the necessary data for a definite plan and estimate, that a survey of the creek be made from the mouth to Goshen Landing, at a cost not to exceed $300. This amount was allotted on November 29, 1890, and the survey was accomplished in May, 1891.

The results of the survey may be summarized as follows: From Goshen Landing to a point about 4,000 feet below, the creek has a low-water depth of from 2 to 4 feet with a minimum low-water width of 20 feet and a high-water width of 30 feet; from thence to the mouth, a distance of about 2,500 feet, a low-water channel from 3 to 5 feet deep exists, with a least width of 30 feet. The ordinary range of the tide is 5 feet. At the mouth there is a sand bar, dry at extreme low water, about 400 feet wide, separating the low-water channel in the creek from the low-water line in Delaware Bay. The upper 4 or 5 feet of this bar and the directly adjacent bed of the bay, for a distance of about 400 feet beyond the low-water line, is composed of sand which is superposed upon a bed of very soft mud. The sand which forms this bar has been derived from the beach south of the mouth of the creek by the action of the wind. The bottom of the bay for several miles outside of the previously described sand line is of soft mud, and this area, from its position, sheltered from all except east winds, is a favorite anchorage for small vessels.

The improvement which is recommended involves the deepening and widening, by dredging, of the 4,000 linear feet of the creek below Goshen

Landing to a low-water depth of 3 feet and a width of 30 feet; the formation of a dredged channel 3 feet deep and about 50 feet wide through the bar at the mouth of the creek and out to the limit of the sand formation beyond the low-water shore line, and the protection of the dredged channel by a sheet-pile jetty on the south side of the channel extending about 600 feet outside of the low-water line of the bay. The material removed from the upper reach of the creek would be cast over upon the adjacent banks. The material obtained from the dredged channel through the outer bar would be cast over behind the sheet-pile jetty, and upon the bank on the south side of the channel between the inner end of the jetty and the mouth of the creek.

The estimated cost of this work is as follows:

600 linear feet of jetty, at $10	$6,000
25,000 cubic yards of dredging, at 20 cents	5,000
Contingencies	1,000
Total	12,000

This estimate is based upon a single appropriation of $12,000, by which the improvement could be made in a single season. The jetty should be constructed and the channel through the outer bar dredged during the same working season, in order that the filling behind the former may be covered by the mud underlying the sand in the channel, and the sand behind the jetty be thus prevented from moving under the action of winds.

The general commercial statistics of Goshen Creek are given in the appended statement.

There is transmitted in a separate package one tracing * covering that part of the creek for which improvement is recommended.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., June 30, 1891.

Respectfully submitted to the Chief of Engineers.

The project is recommended for approval.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

GOSHEN CREEK, NEW JERSEY.

Commercial statistics for the year ending December 31, 1890.

Articles arriving.	Tons.	Articles departing.	Tons.
Lumber	1,200	Wood	6,000
Coal	1,000	Potatoes	120
Grain	1,600	Hay	200
Fertilizers	25	Oysters	1,500
General merchandise	1,200		
Total	5,025	Total	7,820

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* Not printed.

G 22.

EXAMINATION OF DELAWARE BAY, WITH A VIEW OF DETERMINING THE BEST SITE NEAR THE MOUTH OF THE SAME FOR A NATIONAL HARBOR OF REFUGE SUITABLE FOR DEEP-DRAFT VESSELS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 11, 1890.

GENERAL: The Commission of Engineer Officers constituted by paragraph 2, Special Orders No. 66, Headquarters, Corps of Engineers, U. S. Army, September 30, 1890, to examine and report upon a proposed national harbor of refuge for deep-draft vessels near the mouth of Delaware Bay, has the honor to submit the following preliminary report:

The following is the order constituting the Commission:

Special Orders No. 66.

HEADQUARTERS, CORPS OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 30, 1890.

[Extract.]

* * * * * * *

2. By authority of the Secretary of War, a Commission of Officers of the Corps of Engineers, to consist of Col. William P. Craighill, Maj. Charles W. Raymond, Capt. William H. Bixby, will assemble at Philadelphia, Pa., on the call of the senior member, to consider and report upon the subject of a national harbor of refuge near the mouth of Delaware Bay, under the provisions of section 17 of the river and harbor act of September 19, 1890.

Upon the completion of the duty assigned them, the members of the Commission will return to their proper stations.

The journeys required under this order are necessary for the public service.

* * * * * * *

By command of Brigadier-General Casey:

JOHN G. D. KNIGHT,
Captain, Corps of Engineers.

The provisions of law referred to in the order are as follows:

> Delaware Bay with a view of determining the best site near the mouth of the same for a national harbor of refuge suitable for deep-draft vessels. The examination to be made by a commission of three engineer officers, who will make the examination and submit to the Secretary of War a report thereon with a project and estimate of cost of construction of such a harbor of refuge.

The necessity of a harbor of refuge in this vicinity was early recognized; and it was provided for by the construction of the existing harbor at Lewes, Del., which was projected by a commission of distinguished officers in 1828. Notwithstanding the fact that the plans for this harbor have not been fully carried out, it has been of immense benefit to commerce, and numerous reports establish its great value and its national character. At the present time this harbor is inadequate to the needs of commerce and it will continue to be so after the work of breakwater extension now in progress has been completed.

Since this harbor was projected, the number of vessels requiring its shelter has enormously increased. Its anchorage area is far too limited, and its low-water depth of only about 16 feet prohibits its use by the deep-draft vessels of the present day. It will always be of value for the protection of the numerous small vessels passing along the coast in this vicinity, but no extension or improvement can adapt it to the uses of modern deep-draft vessels.

The Commission is not now prepared to submit statistics giving the number and draft of vessels navigating the ocean along this part of the coast to which a deep-water harbor of refuge would be of value, but it is not doubted that such a harbor would be of great benefit to commerce; and its construction would be justified if a suitable location can be found where it can be formed at reasonable expense.

The act of Congress as to this harbor of refuge requires it to be one for deep-draft vessels. The great draft of such vessels of to-day, and the up and down motion and swing of such vessels under heavy wave action, make ample depth and anchorage capacity essential features of the desired harbor of refuge in this bay. It should be near the main channel and easily accessible at all times and in all weather, and should shelter vessels from the prevailing storm winds blowing from east to northwest round by the north, and protect them from floating ice descending from the northwest and north.

The information at present in the possession of the Commission points to the deep-water pocket on the west side of the main ship channel, covered by the shoal known as the "Shears," as the best one for satisfying the required conditions. This position is now a favorite anchorage, is very conveniently located for communication with the shore, the existing harbor, and the channel, and is believed to have the approval of the maritime interests.

A definite decision upon this question should, in the opinion of the Commission, be postponed until after a detailed survey which shall show the present condition (both as to depth and area) of the above-mentioned deep-water pocket, and which shall also show the recent changes in the bottom of the bay in this neighborhood. Accordingly the Commission requests authority to make a survey of this locality and a further examination of others, if necessary, at an expense not to exceed $4,000 as a necessary preliminary to further action.

Respectfully submitted.

Wm. P. Craighill,
Colonel, Corps of Engineers.
C. W. Raymond,
Major, Corps of Engineers.
Wm. H. Bixby,
Captain, Corps of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

G 23.

ESTABLISHMENT OF HARBOR LINES IN THE PORT OF PHILADELPHIA.

Office of the Chief of Engineers,
United States Army,
Washington, D. C., February 19, 1889.

Sir: An advisory board, consisting of one officer of the Corps of Engineers, one officer of the Navy, and a member of the Coast and Geodetic Survey, was appointed by the President in 1880, upon application of the governor of Pennsylvania, to assist a board of harbor commissioners for the port of Philadelphia, newly created by the State and municipal authorities, in establishing a permanent port warden's line for this port on the Delaware and Schuylkill Rivers. This Board is still in existence, and upon its recommendation certain port-warden's lines have been established by the city authorities.

In view of the fact that important conditions are about to arise from the acquisition of the islands in front of Philadelphia, and it being questionable whether, in consideration of the duties imposed on the Secretary of War by section 12 of the river and harbor act of August 11, 1888, the existence of the present board, which has no authority to determine the location of the harbor lines and can only advise the city harbor commissioners, should be continued, it is recommended that it be dissolved and a Board of Engineer Officers be constituted for the establishment of the harbor lines of Philadelphia in order to carry into effect the provisions of the above act.

Should this meet with the approval of the Secretary of War, it is recommended that the proposed Board consist of Col. William P. Craighill, Col. C. B. Comstock, and Lieut. Col. H. M. Robert, of the Corps of Engineers, and with his sanction the order detailing the Board will be issued from this office.

The expenses of the Board to be paid from the appropriations for the improvement of Delaware River until the appropriation for the harbor of Philadelphia becomes available.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. WM. C. ENDICOTT,
Secretary of War.

[First indorsement.]

WAR DEPARTMENT,
February 20, 1889.

The advisory board appointed in 1880 is, by direction of the President, dissolved.

The recommendations of the Chief of Engineers in regard to the appointment of a new Board and the payment of expenses are approved.

WM. C. ENDICOTT,
Secretary of War.

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a. HARBOR LINES FOR EAST SHORE OF DELAWARE RIVER, FROM KAIGHN POINT TO COOPER POINT, ALONG THE WATER FRONT OF CAMDEN, N. J.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 10, 1890.

GENERAL: The Board of Engineers constituted by Special Orders, No. 20, Headquarters, Corps of Engineers, dated February 25, 1889, has the honor to submit the following report upon the establishment of a portion of the harbor lines of the port of Philadelphia:

The order constituting the Board is as follows:

HEADQUARTERS, CORPS OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 25, 1889.

Special Orders, }
No. 20. }

By direction of the Secretary of War a Board of Officers of the Corps of Engineers, consisting of Col. William P. Craighill, Col. Cyrus B. Comstock, Lieut. Col. Henry M. Robert, is constituted to establish the harbor lines of the port of Philadelphia under section 12 of the river and harbor act of August 11, 1888. The Board will meet at Philadelphia, Pa., as soon as practicable, upon the call of the senior member.

Upon completion of the duties assigned them the members of the Board will return to their proper stations.

The journeys required under this order are necessary for the public service.

By command of Brigadier-General Casey:

CLINTON B. SEARS,
Captain of Engineers, U. S. A.

The Board met at the United States Engineer Office, at Philadelphia, for the consideration of this subject on March 2 and 14, 1889. On March 14, 1889, a public meeting was held at the same place to afford an opportunity to persons interested in the subject to express their views regarding the commercial necessities of the harbor.

On February 13, 1890, Maj. C. W. Raymond, Corps of Engineers, relieved Lieut. Col. H. M. Robert, Corps of Engineers, from duty as a member of the Board, by authority of Special Orders, No. 27, Headquarters of the Army, Washington, February 1, 1890.

The Board held meetings at the United States Engineer Office in Philadelphia on June 24, July 10, July 29, and July 30, 1890, and gave public hearings at the rooms of the Board of Trade in Philadelphia on July 10 and July 30, and at the district court room at Camden on July 30, 1890.

A project for the improvement of that portion of the Delaware River which lies between the cities of Philadelphia and Camden, and is known as the port of Philadelphia, involving the widening of the channel and the removal of the islands situated therein, has been adopted by Congress, and the work of excavation is about to be commenced. The establishment of harbor lines in accordance with the physical conditions of the improved river, so located as to require no modifications of the adopted project that will increase the cost of the work, and yet with a due regard for the riparian interests of the two cities, is a matter of great importance and requires careful study and investigation.

At the present time the Board is not prepared to recommend the establishment of harbor lines along the water fronts of the entire harbor. The commercial interests of the city of Philadelphia require the advancement of the line along its front as far as can be done without danger or injurious encroachment upon the navigable channel and without increasing the cost of the work of improvement. The Board reserves its recommendation on this part of the line in the hope that investigations now in progress may establish the practicability of advancing it further than the position heretofore suggested.

In view of the fact that convenient dumping grounds for material excavated in the work of improvement may probably be obtained along the Camdem water front the Board considers it desirable to establish the harbor lines along the New Jersey shore from Kaighn Point to Cooper Point. The establishment of these lines will not practically affect the future location of the lines along the Philadelphia shore, since the deep-water channel contemplated in the existing project can not be shifted towards the Camdem shore without increasing the cost of the improvement, and modifications involving such an increase are prohibited by existing law.

Accordingly the Board recommends the establishment of the following-described harbor lines, consisting of pierhead and bulkhead lines, from Kaighn Point to Cooper Point along the Camden water front in the port of Philadelphia.

DESCRIPTION OF PIERHEAD LINE.

The pierhead line begins at a point in the existing exterior wharf line of the riparian commissioners of New Jersey, in front of Kaighn Point, New Jersey, as adopted December 18, 1873, more particularly described as follows: Beginning at the intersection of the south side of Howell street and the west side of Front street, and running thence southerly along the west side of Front street 230 feet; thence westerly and at right angles to the west side of Front street 200 feet; thence again westerly and on a line parallel with the south side of Kaighn avenue 584 feet to a point in the before-named exterior line.

From the above-described point the pierhead line runs to a point in the prolongation of the south side of Kaighn avenue and distant 1,220 feet westerly from the west side of Second street; thence to a point in the prolongation of the south side of Chestnut street and distant 1,400 feet westerly from the west side of Second street; thence to a point in the prolongation of the north side of Spruce street and distant 1,640 feet westerly from the west side of Second street; thence to a point in the prolongation of the north side of Berkley street and distant 1,963 feet westerly from the east side of Second street; thence to a point in the prolongation of the north side of Mickle street and distant 2,042 feet westerly from the east side of Second street; thence to a point in the prolongation of the south side of Market street and distant 1,623 feet westerly from the west side of front street; thence to a point in the prolongation of the south side of Penn street and distant 1,660 feet westerly from the west side of Front street; thence to a point in the prolongation of the south side of Elm street and distant 1,659 feet westerly from the west side of Front street; thence to a point in the prolongation of a line at right angles to the west side of Front street and 152 feet north of the north side of State street at its intersection with Front street, and distant 1,596 feet westerly from the west side of Front street; thence to a point in the prolongation of the center line of York street and distant 1,562 feet westerly from the west side of Front street; thence to a point in the prolongation of the south side of Erie street and distant 1,410 feet westerly from the west side of Front street; thence on the prolongation of a line passing through the two last-described points to its point of intersection with the existing exterior wharf line of the riparian commissioners of New Jersey adopted January 8, 1887.

DESCRIPTION OF BULKHEAD LINE.

The bulkhead line is described as follows: Beginning at a point in the before-described pierhead line where the prolongation of the south side of Chestnut street is distant 1,400 feet westerly from the west side of Second street, and running thence to a point in the prolongation of a line parallel with and 372 feet northerly from the intersection of the north side of Mickle street with the east side of Second street and distant 1,795 feet westerly from the east side of Second street; thence to a point in the prolongation of a line 20 feet north of and parallel with the south side of State street and distant 1,602 feet westerly from the west side of Front street; thence to a point where the prolongation of a line at right angles to the west side of Front street and 152 feet north of the north side of State street and distant 1,596 feet westerly from the west side of Front street intersects with the before-described pierhead line.

The above-described lines are shown upon the accompanying map* compiled from surveys made in September, 1890, under the direction of Maj. C. W. Raymond, Corps of Engineers.

Respectfully submitted.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 30, 1890.

Respectfully submitted to the Secretary of War.

It having become manifest to the Secretary of War that the establishment of harbor lines was essential to the preservation and protection of the port of Philadelphia, a Board of Engineers was by his direction constituted by Special Orders, No. 20, Headquarters, Corps of Engineers, February 25, 1889, to establish such harbor lines in accordance with the provisions of the river and harbor act of August 11, 1888.

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* Omitted. See sketch of Philadelphia Harbor.

In compliance with this order the said Board of Engineers has held various meetings and now submits a partial report, recommending for the approval of the Secretary of War the pierhead and bulkhead lines for the easterly shore of Delaware River from Kaighn Point to Cooper Point, New Jersey, described in the within report and delineated upon the accompanying chart.

It is recommended that the lines selected be approved and that the Secretary place his approval both upon the report and the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
November 1, 1890.

Approved as recommended by the Chief of Engineers.

L. A. GRANT,
Acting Secretary of War.

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b. HARBOR LINES FOR WEST SHORE OF DELAWARE RIVER, FROM MOORE STREET TO OTIS STREET, ALONG THE WATER FRONT OF PHILADELPHIA, PENNSYLVANIA.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 2, 1891.

GENERAL: The Board of Engineers constituted by Special Orders, No. 20, Headquarters, Corps of Engineers, dated February 25, 1889, has the honor to submit the following report upon the establishment of the harbor lines on the Philadelphia water front of the port of Philadelphia.

In its report of October 10, 1890, the Board recommended the establishment of the harbor lines of the port on the Camden water front from Kaighn Point to Cooper Point. These lines were approved by the War Department on November 1, 1890.

In the report referred to the Board remarked as follows:

> At the present time the Board is not prepared to recommend the establishment of harbor lines along the water fronts of the entire harbor. The commercial interests of the city of Philadelphia require the advancement of the line along its front as far as can be done without dangerous encroachment upon the navigable channel and without increasing the cost of the work of improvement. The Board reserves its recommendation on this part of the line in the hope that investigations now in progress may establish the practicability of advancing it further than the position heretofore suggested.

The investigations then in progress have been completed and the results were considered at a meeting of the Board held on this date at the United States Engineer office in Philadelphia, all the members being present. With the information now available the Board recommends the following-described harbor lines, consisting of pierhead and bulkhead lines from Moore street to Otis street along the Philadelphia water front in the port of Philadelphia, as in its opinion the best that can be established, considering the physical conditions of the water-way and the commercial requirements of the city. The Board is of the opinion that this is the most advanced position of the pierhead line that can safely be adopted:

DESCRIPTION OF PIERHEAD LINE.

Beginning at a point in the existing port warden's line for the city of Philadelphia 970 feet southerly from the point "T," as defined by ordinance of councils approved May 18, 1886, and running thence to a point on the prolongation of the north side of Wharton street and distant 742 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Christian street and distant 740 feet from the west side of Delaware avenue; thence to a point on the prolongation of the north side of South street and distant 712 feet from the west side of Delaware avenue; thence to a point on the prolongation of the north side of Spruce street and distant 735 feet from the west side of Delaware avenue; thence to a point on the prolongation of the north side of Chestnut street and distant 700 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Arch street and distant 700 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Vine street and distant 700 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Willow street and distant 667 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Poplar street, and distant 750 feet from the west side of Delaware avenue; thence to a point on the prolongation of the south side of Shackamaxon street and distant 732 feet from the west side of Delaware avenue; thence to a point at the intersection of the prolongation of the south side of Otis street and the existing port-warden's line of the city of Philadelphia as defined in ordinance of councils approved December 4, 1856.

DESCRIPTION OF BULKHEAD LINE.

The bulkhead line lies to the east of Delaware avenue and is described as follows: Beginning at a point 150 feet easterly from and perpendicular to the west side of Delaware avenue at a point 140 feet southerly from the south side of Moore street, and running thence to a point 150 feet from and perpendicular to the west side of Delaware avenue at a point 62 feet southerly from the south side of Federal street; thence to a point 150 feet from and perpendicular to the west side of Delaware avenue between Spruce and Pine streets at a point 92.5 feet southerly from the south side of Spruce street; thence to a point in the prolongation of the north side of Market street and distant 150 feet from the west side of Delaware avenue; thence to a point in the prolongation of the south side of Vine street and distant 150.75 feet from the west side of Delaware avenue; thence to a point 150 feet from and perpendicular to the west side of Delaware avenue between Fairmount avenue and Green streets at a point 35 feet southerly from the south side of Fairmount avenue; thence to a point in the prolongation of a line 20 feet northerly from and parallel with the south side of Shackamaxon street and distant 78 feet easterly from the prolongation of the west side of Delaware avenue; thence to a point in the prolongation of the south side of Otis street and distant 90 feet from the west side of Beach street.

These lines are located so as to conform to the conditions which will exist when the islands and shoals have been removed and the improvement of the harbor has been completed. The advance of wharves to them at the present time would obstruct the existing navigable channel and be followed by other injurious results; yet it is desirable that such advance should be not only permitted but encouraged at proper times and places during the progress of the work. Accordingly the Board recommends the establishment of these lines subject to the condition that wharves shall only be extended beyond the present legal port warden's lines at such times and places as may be approved by the Secretary of War.

The conditional establishment of these lines at the present time as recommended is very desirable to enable the State and municipal authorities and the local interests to provide intelligently for the reconstruction of the water front. A letter from the committee of commerce and transportation of the Manufacturers' Club of Philadelphia, showing the desirability of immediate action, is transmitted herewith.

The Board is of the opinion that the establishment of harbor lines other than those recommended is not expedient at the present time.

The lines recommended are shown on the accompanying map.*

Respectfully submitted.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen.
C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 17, 1891.

Respectfully submitted to the Secretary of War.

The Board of Engineers constituted by authority of the Secretary of War to consider the question of harbor lines of Philadelphia submits the within report, recommending establishment of pier and bulkhead lines from Moore street to Otis street along the Philadelphia water front, in the port of Philadelphia, as described in the within report and delineated upon the accompanying map.

It is recommended that the lines selected be approved and that the Secretary place his approval both upon the report and the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT,
January 20, 1891.

Approved and respectfully returned to the Chief of Engineers.

L. A. GRANT,
Assistant Secretary of War.

LETTER FROM COMMITTEE ON COMMERCE AND TRANSPORTATION OF THE MANUFACTURERS' CLUB OF PHILADELPHIA.

MANUFACTURERS' CLUB OF PHILADELPHIA,
Philadelphia, December 31, 1890.

SIR: We beg to refer you to the communication upon the subject of harbor improvements addressed to the Board of Engineers on July 28, 1890, by the various commercial bodies of Philadelphia, and to say that it has, in its general features, our hearty approval.

We will be glad to coöperate actively with these bodies in obtaining the State and municipal legislation required to reach the desired end.

Supplementing the communication referred to, we wish to submit on behalf of the Manufacturers' Club of Philadelphia at this time the following outline of a scheme as a basis for the required legislation:

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* Omitted. See sketch of Philadelphia Harbor.

Two of the leading accessories necessary to place Philadelphia on the highest plane of fitness as a focus for international commerce have passed safely through the preliminary stages of discussion, of designing, and of full authorization. It is also certain they will soon pass through the one stage yet remaining, namely, that of completed construction.

These are a well-remodeled and capacious harbor, and a belt-line railway, designed to give cheap, impartial, and capable rail connection between all the west shore appliances of that harbor and every great railway artery which does now or may hereafter connect this city with the entire country of the United States.

Another feature of vital importance should now be taken up, discussed, designed, and executed. It is the arrangement of the western or Philadelphia side of our new harbor. If this arrangement be badly planned, or but partially or imperfectly executed, the harbor and the belt line will show poor results. It will be the very heart of the entire system, and upon its effectiveness will depend the vigor and volume of the whole commercial circulation.

Certain of the considerations which must govern a wise decision upon the features of this most important matter can already be clearly perceived. Some of them are as follows:

1. The improvements must be so designed as to harmonize with the general plan of harbor improvement which may, after all needful conferences, be finally adopted by the United States authorities.

2. It must, therefore, be a design not subject to modification or neglect by individual owners, through either caprice, greed, or indifference, but one which shall be finally and authoritatively determined, and, if necessary, executed by a single body or commission armed with ample power.

3. It should clearly be intrusted to a commission of trained and trusted citizens, which should embrace in its body persons of known ability in the several branches of engineering, financiering, transportation, and commerce.

4. The commission should, as has been done in like cases in other great commercial centers, such as Antwerp, Liverpool, New York, and Montreal, be invested (for the purposes confided to it) with the right of eminent domain, with power to raise money for construction upon a mortgage of the property placed in its charge, and which it may acquire or create, and of the revenue therefrom, with the right to fix and collect tariffs for the use of such property, and appropriate these collections to expenses, interest, etc.

5. The right to acquire and own the amplest accommodations for the traffic of each railroad company and each steamship line should be permitted to such organizations, subject to the one condition that their improvements shall be brought into conformity with the general plan hereafter adopted.

6. Abundant accommodation should be provided for every sort of transient vessel, car, or vehicle, and for every kind of trade seeking transfer between land and water. Every description of approved appliances for cheapening and quickening such transfers should be provided therefor.

7. To create such a commission will require legislative action, and this action should be promptly procured, and in a well-devised and lawful form.

8. The shore plan will clearly require piers of abundant length (some long enough to shelter the largest steamships likely to be soon constructed), of ample width to accommodate railway tracks, and furnish temporary storage of cargoes, separated by docks wide enough to accommodate, on each side, a vessel of the extremest width, with abundant operating space between them. It will require a shoreway between bulkhead line and building line of a width sufficient to provide for sheds along the bulkheads (in which transferring can be done as well as on piers, and which can ultimately support above an elevated railway for passenger service), for plenty of railway tracks, and for wide wagon and foot ways. Hence the Board of United States Engineers should at once be urged to fix the pier line on the Philadelphia side of the river, as much towards the east as a proper reference to the needed width and depth of the river will permit. It ought to be so located, if practicable, as to be at least 1,000 feet east of the present building line on the west side of Delaware avenue.

Respectfully, your obedient servants,

CHARLES N. THORPE,
B. C. POTTS,
CHAS. HEBER CLARK,
WM. NELSON WEST,
JOHN G. CROXTON,
THEODORE JUSTICE,
FRANK L. NEALL,
Committee on Commerce and Transportation of the Manufacturers' Club of Philadelphia.

Maj. C. W. RAYMOND,
Corps of Engineers.

LETTER OF MAJOR C. W. RAYMOND, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 31, 1890.

GENTLEMEN: I beg to acknowledge the receipt of your letter of this date with reference to the improvement of Philadelphia Harbor and the reconstruction of the water front. I will lay it before the Board of Engineers at its meeting on January 2, and I assure you that it will receive the most careful consideration.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

MR. CHARLES N. THORPE AND OTHERS,
Committee on Commerce and Transportation,
Manufacturers' Club, Philadelphia, Pa.

c. PROPOSED CHANGE IN THE HARBOR LINES OPPOSITE PETTY ISLAND, IN THE DELAWARE RIVER.

LETTER OF J. WARREN COULSTON, COUNSEL FOR THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING COMPANY, AND OTHERS.

PHILADELPHIA, PA., *January 8, 1891.*

SIR: As counsel for The William Cramp & Sons Ship and Engine Building Company and others, we have the honor to submit herewith copies of two communications and a plan, which were presented to the Board of Engineers appointed to recommend to the honorable Secretary of War permanent harbor lines on the Delaware River, in which, among other things, it is proposed to purchase and donate to the United States Government, for the purposes mentioned, a strip of land upon Petty Island.

From an intimation which has been made to us, we are led to believe that the Board considers that the proposition made to it does not come within the scope of its instructions, and we therefore most respectfully request that you will refer the same to it for investigation, and report to you, upon the feasibility and desirability of fixing the harbor lines on Petty Island and on the western side of the channel opposite thereto, as has been proposed in the communications to the Board herein referred to, or with such modifications thereof as the Board may in its discretion deem wise in view of the large interests located in that vicinity.

We beg to submit to you that an investigation will disclose the fact that the shipbuilding yards opposite Petty Island have no room to build large ships, unless facilities are granted by which the launching ways can be extended further to the eastward. As the modern type of steamship is between 500 and 600 feet in length, and additional room by the extension of the harbor lines is necessary, we beg that you will accede to the request herein made.

Your obedient servant,

J. WARREN COULSON,
Counsel for The William Cramp & Sons Ship and Engine Building Co.; Charles Hillman, Ship and Engine Building Co.; Neafie & Levy, Ship-builders, and others.

HON. REDFIELD PROCTOR,
Secretary of War.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 13, 1891.

Respectfully referred to the Board of Engineers constituted to consider and report upon the subject of harbor lines of the port of Philadelphia, Pa.

H. M. ADAMS,
Major, Corps of Engineers, in charge.

[Second indorsement.[

U. S. ENGINEER OFFICE,
Baltimore, Md., January 20, 1891.

Respectfully returned to the Chief of Engineers, accompanied by a report from the Board.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers, U. S. A.

LETTER OF THE WILLIAM CRAMP & SONS SHIP AND ENGINE BUILDING COMPANY.

PHILADELPHIA, PA., *January 9, 1891.*

SIR: I have read and approved the communication of our counsel of this date, relative to the extension of the harbor lines on the Delaware River, and the request therein contained, and I earnestly urge a prompt reference of the subject to the Board of Engineers of the harbor lines on the Delaware River.

I have the honor to be, your obedient servant,

THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING CO.,
CHAS. H. CRAMP, *President.*

Hon. REDFIELD PROCTOR,
Secretary of War.

CHAP. 194.—An act to facilitate the prosecution of works projected for the improvement of rivers and harbors.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War may cause proceedings to be instituted, in the name of the United States, in any court having jurisdiction of such proceedings, for the acquirement by condemnation of any land, right of way, or material needed to enable him to maintain, operate, or prosecute works for the improvement of rivers and harbors for which provision has been made by law; such proceedings to be prosecuted in accordance with the laws relating to suits for the condemnation of property of the States wherein the proceedings may be instituted: *Provided, however,* That when the owner of such land, right of way, or material shall fix a price for the same, which in the opinion of the Secretary of War shall be reasonable, he may purchase the same at such price without further delay: *And provided further,* That the Secretary of War is hereby authorized to accept donations of lands, or materials required for the maintenance or prosecution of such works.

Approved April 24, 1888.

LETTER OF THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING COMPANY.

PHILADELPHIA, PA., *July* 16, 1890.

GENTLEMEN: The undersigned are owners of property in the city of Philadelphia fronting on the Delaware River, opposite Petty Island.

They respectfully submit to your honorable body a plan upon which two parallel lines have been drawn in red, at a distance of 2,000 feet from each other, which they ask shall be laid down as the harbor lines in that locality. The interests represented by us require very long piers, and so important is this that if the honorable Secretary of War shall, in his wisdom, adopt and fix the exterior wharf lines as above-described and located, the strip of ground on Petty Island lying between the line in red and the easterly line upon which the proceedings in condemnation of property upon Petty Island were had, will be purchased by the undersigned and ceded to the United States, without charge.

THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING CO.,
CHAS. H. CRAMP, *President.*

Col. W. P. CRAIGHILL,
Col. C. B. COMSTOCK,
Maj. C. W. RAYMOND,
Board of Engineers on Harbor Lines.

LETTER OF THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING COMPANY, AND OTHERS, OWNERS OF PROPERTY FRONTING ON THE DELAWARE RIVER OPPOSITE PETTY ISLAND.

PHILADELPHIA, PA., *July 16, 1890.*

GENTLEMEN: The undersigned are owners of property in the city of Philadelphia fronting on the Delaware River opposite Petty Island.

They respectfully submit to your honorable body a plan upon which two parallel lines have been drawn in red, at a distance of 2,000 feet from each other, which they ask shall be laid down as the harbor lines in that locality, because the business interests represented by them require very long piers, and it is absolutely necessary that provision shall be made for an extension of them beyond the present port warden line.

THE WM. CRAMP & SONS SHIP AND ENGINE BUILDING CO.,
CHAS. H. CRAMP, *President.*
J. P. MORRIS & CO., JAMES B. THOMPSON, *Vice-President.*
HUGHES & PATTERSON, DELAWARE ROLLING MILLS.
BUTCHER'S ICE AND COAL CO. (LIMITED).
KENSINGTON ENGINE WORKS (LIMITED).
CHARLES HILLMAN & CO.
NEAFIE & LEVY.
LEHIGH VALLEY R. R. CO.,
By CHAS. HARTSHORNE, *Vice-President.*
THE LEHIGH COAL AND NAVIGATION CO.,
By J. S. HARRIS, *President.*

Col. W. P. CRAIGHILL,
Col. C. B. COMSTOCK,
Maj. C. W. RAYMOND,
Board of Engineers on Harbor Lines.

LETTER OF THE ASSISTANT SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, January 12, 1891.

SIR: I have, agreeably to your request, submitted to the Engineer Corps the papers you left with me the other day in reference to the change of the harbor lines in the Delaware River at Philadelphia, and the matter will no doubt be submitted by the Chief of Engineers to the Board on harbor lines at Philadelphia.

In this connection I beg leave to call your attention to the fact that the project was submitted to Congress, and upon that the appropriation of $200,000 was made. That project being the one on which Congress acted, there is no authority to go outside of it and to use any of the money appropriated for excavating on Petty Island east of the line already established. If the desired change of lines is made, it will probably be necessary for some provision to be made for excavating from the present line back to the line to be established. Your attention is respectfully called to page 4 of the river and harbor act of September 19, 1890, commencing at the bottom of page 4 and extending on the top of page 5.

The work has been advertised for bidders.

Very respectfully,

L. A. GRANT,
Assistant Secretary of War.

J. WARREN COULSTON, Esq.,
Philadelphia, Pa.

REPORT OF THE BOARD OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 20, 1891.

GENERAL: The Board of Engineers, constituted by Special Orders, No. 20, Headquarters, Corps of Engineers, dated February 25, 1889, to establish the harbor lines of the port of Philadelphia, has the honor to submit the following report upon a proposed change in the harbor lines opposite Petty Island, in the Delaware River, requested by Mr. J. Warren Coulston, attorney for William Cramp & Sons, and other shipbuilding firms, in letter to the Secretary of War, dated January 8, 1891, which letter was referred to the Board by your indorsement of the 13th instant:

It is proposed to advance the harbor line on the Philadelphia shore so as to afford needed facilities for the construction and launching of large ships, and to partly compensate for this advance by increasing the excavation along the north shore of Petty Island, the parties interested offering to donate to the United States the additional land on the island necessary for this purpose. The lines proposed are shown upon the map accompanying Mr. Coulston's letter.

The existing harbor lines conform to the adopted project for the improvement of the harbor. The proposed modification of these lines narrows the projected width of the Petty Island Channel from 2,000 feet to 1,900 feet. This change the Board considers undesirable, but the objection can be obviated by placing the harbor line 100 feet further towards the Philadelphia shore. The modification, thus amended, involves the removal of additional material to the extent of about 900,000 cubic yards at an estimated cost of about $180,000. It also involves a change of about 4° in the direction of the axis of the Petty Island channel, but the Board considers this a not very serious objection.

The adoption of the proposed harbor lines will require a modification of the project for the improvement of Philadelphia Harbor, increasing the cost thereof, and this is contrary to the provisions of the river and harbor act of September 19, 1890. The Board sees no strong objection to the modification, amended as above so as to retain a channel width of 2,000 feet, provided the additional cost involved for dredging, land, and all other purposes, be defrayed without expense to the United States.

Mr. Coulston's letter to the Secretary of War, with accompanying inclosures, is herewith returned.

Respectfully submitted.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.
C. B. COMSTOCK,
Col. of Engrs. and Bvt. Brig. Gen.
C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

ADDITIONAL INDORSEMENTS ON LETTER OF J. WARREN COULSTON, ESQ., DATED JANUARY 8, 1891, TO THE SECRETARY OF WAR, REFERRED TO THE BOARD OF ENGINEERS.

[Third indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 23, 1891.

Respectfully returned to the Secretary of War.

In the matter of proposed change desired by shipbuilding firms in harbor lines in Delaware River, at Philadelphia, opposite Petty Island.

This paper was referred to the Board of Engineers, constituted to consider and report upon the subject of harbor lines of the port of Philadelphia, and the report of the Board in regard to the matter is herewith submitted. This report of the Board is concurred in by me.

In view of the letter of the Assistant Secretary of War, of January 12, it is recommended that the papers be filed.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fourth indorsement.]

WAR DEPARTMENT,
January 24, 1891.

Respectfully returned to the Chief of Engineers with his recommendation approved.

It is, however, suggested that it would be well to forward to the petitioners, directed to J. Warren Coulston, esq., 505 Chestnut street, Philadelphia, Pa., a copy of the report of the Board of Engineers, having in charge the harbor lines at Philadelphia, inasmuch as it was suggested to him that the petition would be referred to that Board, and it is possible that it may bring out a proposition to raise the necessary money for the additional dredging.

L. A. GRANT,
Assistant Secretary of War.

[Fifth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 6, 1891.

Respectfully returned to the Secretary of War.

In the matter of modification of project for the improvement of the harbor of Philadelphia.

The sundry civil bill, approved March 3, 1891, provides that—

> For improving harbor at Philadelphia, Pa.: Continuing improvement, removal of Smith Island and Windmill Island, Pennsylvania, and Petty Island, New Jersey, and adjacent shoals, $300,000: *Provided,* That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may consider desirable, and the material to be removed from said islands and shoals under this appropriation and appropriations heretofore made, shall be deposited and spread on League Island, and to the extent of the cost of such deposit and spreading the said appropriations are hereby made available: *Provided further,* That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter.

It is recommended that the project for improvement of Philadelphia Harbor be modified by changing the boundary of the part of Petty

Island to be removed to the red line shown on the blue print herewith, provided, "That the title to any additional lands acquired for the purpose shall be vested in the United States without charge to the latter."

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Sixth indorsement.]

WAR DEPARTMENT,
March 7, 1891.

Approved as recommended by the Chief of Engineers.

L. A. GRANT,
Asst. Secretary of War.

[Seventh indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 7, 1891.

Respectfully referred to Maj. C. W. Raymond, Corps of Engineers, for his information and guidance. Attention is called to the fifth and sixth indorsements. Major Raymond will please have the new line staked out on Petty Island and inform Mr. Coulston of the conditions under which the project is modified.

To be noted and returned to this office.

By command of Brigadier-General Casey.

H. M. ADAMS,
Major, Corps of Engineers.

[Eighth indorsement.]

U. S. ENGINEER OFFICE,
Philadelphia, Pa., March 10, 1891.

Respectfully returned to the Chief of Engineers, U. S. Army.

In compliance with Department instructions contained in the seventh indorsement, Mr. Coulston has been notified of the conditions under which the project is modified by the Secretary of War; and the new line on Petty Island will be staked out as soon as the weather permits.

C. W. RAYMOND,
Major, Corps of Engineers.

APPENDIX H.

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, AND ON EASTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA; AND OF INLAND WATER-WAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, DELAWARE.

REPORT OF WM. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED, IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Wilmington Harbor, Delaware.
2. Ice-harbor at New Castle, Delaware.
3. Appoquinnimink River, Delaware.
4. Smyrna River, Delaware.
5. St. Jones River, Delaware.
6. Mispillion Creek, Delaware.
7. Broadkiln River, Delaware.
8. Inland water-way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Delaware.
9. Susquehanna River, above and below Havre de Grace, Maryland.
10. North East River, Maryland.
11. Elk River, Maryland.
12. Fairlee Creek, Maryland.
13. Chester River, Maryland, from Crumpton to Jones Landing.
14. Choptank River, Maryland.
15. Cambridge Harbor, Maryland.
16. Wicomico River, Maryland.
17. Manokin River, Maryland.
18. Onancock Harbor, Virginia.
19. Harbor at Cape Charles City, Virginia, and approaches by Chenton (Cherrystone) Inlet.
20. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

21. Linchester River, Maryland.
22. Nanticoke River, Maryland, the northwest fork of the same.
23. Tangier Harbor, Virginia.
24. Broad Creek River, Delaware.
25. Turner Creek, Maryland.
26. La Trappe [River], Maryland.
27. Warwick [River], Maryland.
28. Broad Creek, Maryland.

HARBOR LINES.

29. Establishment of harbor lines at New Castle, Delaware.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 9, 1891.

GENERAL: I have the honor to transmit herewith the annual report for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1891.

I was ably assisted during the year by Mr. A. Stierle, assistant engineer, in the prosecution of these works.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

H I.

IMPROVEMENT OF WILMINGTON HARBOR, DELAWARE.

The river and harbor act of September 19, 1890, appropriated $30,000 for the improvement of this harbor, and on January 21, 1891, a contract was made with the Atlas Dredging Company, of Wilmington, Del., for dredging, in accordance with the approved project. The contract price, 8 cents per cubic yard, measured in scows, is an unusually low one and permits of removing a larger amount of material than was contemplated.

Operations began on February 11, 1891, above the railroad bridge of the branch of the New Castle cut-off, below the mouth of Brandywine Creek, at a point where dredging was suspended at the close of operations in 1889. At the end of the fiscal year 235,340 cubic yards had been removed, and $17,143.39 had been expended making a channel 5,200 feet long from the place of beginning to a point 600 feet above the Third Street Bridge, 150 feet wide and 15 feet deep at mean low water. The dredged material was mud and was deposited in a cove of the Delaware River below Edgemoor. The work is still in progress and will be completed, it is expected, by August 1, 1891.

The approved project is for a 15-foot low-water channel 150 feet wide from the mouth of the Christiana River to the Rolling Mill Wharf, 4,750 feet above the outer end of the jetty; 100 feet wide from this wharf to the Delaware and Western Railroad Bridge, and 75 feet wide from this bridge to the pulp works; also, a channel 12 feet deep and 50 feet wide from the pulp works to the Delaware Railroad Bridge, and the construction of a jetty at the mouth of the river. This project was recommended by a Board of Engineers in 1881, at an estimated cost of $175,551. The construction of the jetty and dredging operations were begun the following year. On page 662, Annual Report of the Chief of Engineers for 1883, a revised estimate is given for the completion of the project. This estimate increases the channel width of the whole section from the Rolling Mill Wharf to the pulp works to 150 feet, and makes no provision for a 12-foot channel from the pulp works to the Delaware Railroad Bridge, the total cost being given at $191,384, exclusive of the cost of the jetty, which was then nearly completed.

A change in the plan of the jetty was made in 1884, providing for an additional height of 4 feet and an extension of 322 feet in length.

Up to the year 1871 the General Government had at various times expended $32,356 in improving the navigable channel of the Christiana River. Between the years 1871 and 1881 improvements continued under a project for a 12-foot low-water channel 100 to 200 feet wide, and $83,000 were expended to complete it. Since 1881 $170,914.44 have been expended, making a total of $303,913.83 at the close of the fiscal year ending June 30, 1891.

As the river and harbor act of September 19, 1890, directs the Secretary of War to appoint a commission, who shall make a survey of the tidal streams forming the harbor of Wilmington and a report and plan for a permanent improvement, the usual recommendation for the application of any funds for the fiscal year ending June 30, 1893, is omitted.

Wilmington is a port of entry and in the collection district of Delaware. The amount of revenue collected during the fiscal year ending June 30, 1891, is $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—		By act approved—	
July 14, 1836	$15,000	March 3, 1879	$3,500
March 3, 1837	8,000	June 14, 1880	10,000
July 7, 1838	9,356	March 3, 1881	50,000
July 11, 1870	15,000	By act passed August 2, 1882	50,000
June 10, 1872	10,000	By act approved—	
March 3, 1873	6,000	July 5, 1884	25,000
June 23, 1874	6,000	August 5, 1886	18,750
March 3, 1875	10,000	By act of August 11, 1888	30,000
August 4, 1876	16,000	By act approved September 19, 1890	30,000
June 18, 1878	7,000		

The sum of $2,411.22 of the above appropriations has been carried to the surplus fund of the Treasury.

Money statement.

July 1, 1890, balance unexpended		$2,835.56
Amount appropriated by act approved September 19, 1890		30,000.00
		32,835.56
June 30, 1891, amount expended during fiscal year		17,143.39
July 1, 1891, balance unexpended		15,692.17
July 1, 1891, outstanding liabilities	$5,365.27	
July 1, 1891, amount covered by uncompleted contracts	5,172.80	
		10,538.07
July 1, 1891, balance available		5,154.10
Amount (estimated) required for completion of existing project		87,634.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		87,634.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals received and opened January 12, 1891, by Gen. Wm. F. Smith, United States Agent, for dredging in Wilmington Harbor, Delaware.

No.	Name and address of bidder.	Time.		Price per cubic yard measured in scows.
		Commence.	Complete.	
				Cents.
1	Frank C. Somers, Camden, N. J	Apr. 1, 1891	Sept. 30, 1891	11¾
	Atlas Dredging Company, Wilmington, Del	do	June 30, 1891	8
	National Dredging Company, Wilmington, Del	do	Dec. 1, 1891	8.9

Contract with Atlas Dredging Company.

COMMERCIAL STATISTICS.

Maritime business of Wilmington, Del., from data kindly furnished by Mr. E. Kershaw, harbor master, for the year ending December 31, 1890.

Class.	Tons.	Value.
Raw products	372, 947	$1, 692, 000
Manufactured products	119, 050	13, 100, 000
Agricultural products	3, 600	99, 800
General merchandise	72, 600	3, 630, 000
Total	568, 197	18, 521, 800

Vessels trading in Wilmington Harbor, Delaware.

Class of vessel.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Passenger steamers	8	644	6½ to 8½	Twice a day each.
Freight steamers	6	1, 517	7 8	Daily and weekly.
Tugboats	5	228	4 8	Constantly.
Schooners	14	4, 267	4 12	Do.

Number of passengers carried 117, 910

Vessels built and repaired at Wilmington, Del., during the year ending June 30, 1891.

Class of vessel.	No.	Registered total tonnage.	Draft of largest vessel when leaving ship yard.	Calculated maximum draft, when loaded, of largest vessel built.
Built:			*Feet.*	*Feet.*
Passenger steamers	3	1, 585	4¾	4¾
Freight steamers	5	8, 910	12½	23
Passenger and freight steamers	7	7, 802	....	....
Towing steamer	2	284	....	....
Revenue steamers	1	280	....	....
Schooners	1	1, 126	9	18½
Scows, barges, and floats	7	8, 043	....	....
Repaired:				
Steamers	59	5, 192	....	....
Sail vessels, barges, and scows	99	20, 805	....	....

These data were furnished by the following shipbuilding firms: The Harlan & Hollingsworth Company, the Jackson & Sharp Company, the Pusey & Jones Company, and Enoch Moore.

REPORT OF COMMISSION ON IMPROVEMENT OF WILMINGTON HARBOR, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., June 18, 1891.

The Commission constituted by Special Orders, No. 66, Headquarters, Corps of Engineers, dated Washington, D. C., September 30, 1890, to consider and report upon the improvement of the harbor of Wilmington, Del., under the provisions of the river and harbor act of September 19, 1890, has the honor to submit the following report:

The act of September 19, 1890, provides as follows:

> The Secretary of War is directed to appoint a commission of three persons, one of whom shall be a civil engineer of experience in the improvement of rivers and harbors, who shall proceed to make an accurate survey of the tidal streams which form the harbor of Wilmington, Delaware, making all necessary observations to obtain all the data required for a plan for the permanent improvement of the harbor to suit the present and prospective wants of commerce and navigation; and that said commissioners shall, as soon as possible, make to the Secretary of War a report, submitting with it a plan for the improvement of said harbor.

By order of the senior member, the Commission was convened at Wilmington, Del., October 22, 1890. After a review of existing maps and data relating to the improvement an inspection was made of the harbor, and the following general plan was adopted as to the character and extent of the surveys and tidal observations which would be required for the discharge of the duties of the Commission: A complete resurvey of Christiana River from its mouth to the pulp works, including a survey of the Delaware River in front of the mouth of the Christiana; an examination of Brandywine Creek between its junction with the Christiana and Market Street Bridge for the purpose of comparison with the survey of 1883; current and tidal observations to be made at the mouth of the Christiana and in the Delaware River adjacent thereto, at the confluence of the Brandywine, and in the reach of river near the pulp works; and a reconnoissance of the Brandywine and Christiana above tidal influence, to determine the inflow into the basin from above such points.

The field work for the foregoing was accomplished in November and December, 1890; it was subsequently determined that rock borings were required in the vicinity of Third Street Bridge, and these were made in April, 1891.

Upon the completion of the maps of the survey, and at the request of those interested in the improvement, the Commission held a public meeting at Wilmington, Del., on February 16, 1891. At this meeting the leading commercial interests of the city were represented, and after a full expression of opinion a series of resolutions was transmitted to the Commission indicating the character and extent of the desired improvement, which may be summarized as follows: The formation by dredging of a channel in the Christiana River from its mouth to the Delaware and Western Railroad Bridge 300 feet wide and 24 feet deep at mean low water, and from thence to the upper bridges a channel 20 feet deep; the protection of the shores of the river by revetment at all places where permanent wharves are not erected; the formation of a cut-off through the neck of land separating the Brandywine and Christiana, and the formation of a channel in the Brandywine 150 feet wide and 10 feet deep from the Christiana to the Market Street Bridge. A copy of the resolutions is appended hereto.

DESCRIPTION OF WILMINGTON HARBOR.

Christiana River discharges into the Delaware River at a point about 30 miles below the city of Philadelphia. One and a half miles above its mouth is the confluence of Brandywine Creek, and the city of Wilmington is located upon the area directly west of the junction of these streams. The harbor of Wilmington includes about 4 miles of the Christiana River above its junction with the Delaware, and 2 miles of Brandywine Creek above its confluence with the Christiana.

Between the mouth and the upper part of the harbor on the Christiana 9,500 linear feet of the left bank is covered by wharfing and revetment, and about 10,000 feet by earth dikes; on the right bank 2,000 linear feet is covered by wharfing, and the remaining 17,500 linear feet by earth dikes. The principal wharves of the city are assembled along the upper 2 miles of the left bank. A few wharves have been built at detached localities on the upper half of the Brandywine, the remainder of the shore line being covered by dikes similar to those on the Christiana.

The land dikes form the high-water bank of the streams, and protect the adjacent meadow lands, which have a general elevation of about 3 feet above low water, from overflow. These dikes ere built to a height of about 4 feet above ordinary high water and their river slopes are protected against the wash of the currents by a random stone facing. Between the low-water line and the foot of the dikes there is usually a berme of from 50 to 150 feet, which has been raised by river deposits since the dikes were built to an elevation 2 or 3 feet above the natural surface of the shore.

Within the limits of the harbor of Wilmington the Christiana is crossed by the following drawbridges:

Name of bridge.	Distance from mouth.	Number of spans.	Width of clear opening.
	Miles.		*Feet.*
Philadelphia, Wilmington and Baltimore Railroad (branch line)	1.0	2	90
Third Street Highway Bridge	2.0	2	90
Market Street Highway Bridge	2.7	2	100
Delaware and Western Railroad	3.2	2	65
Philadelphia, Wilmington and Baltimore Railroad Cut-off	3.5	2	65
Wilmington and Northern Railroad	3.6	2	65

Within the same limits the Brandywine is crossed by two bridges; the main line of the Philadelphia, Wilmington and Baltimore Railroad with two draw spans each, with a clear opening of 35 feet; and the Eleventh Street Highway Bridge, with two spans of 40 feet opening.

About 12 miles above its mouth the Christiana River divides into three branches, viz: Red Clay Creek, flowing from the north; White Clay Creek, from the west; and Christiana Creek from the southwest. Tidal influence extends to dams about 2 miles above the junction of these affluents, or to a point about 14 miles above the mouth of the Christiana River. The headwaters of these streams are near the boundary line between Delaware and Maryland at an elevation of about 100 feet above sea level.

The Brandywine has its origin in the northern part of Chester County, Pa., at an elevation of about 500 feet above the sea, and flowing southeasterly discharges into Christiana River about 1½ miles above the mouth of the latter. Tidal influence extends upon the Brandywine to the lower dam, or about 2 miles above its mouth.

An approximate determination of the quantity of water in these streams coming from above tidal influence during their average low-water stages gave for Christiana River about 90 cubic feet and for Brandywine Creek about 140 cubic feet per second. No approximation of their freshet discharges has been possible, but in general terms it may be said that the freshets in the former stream are very moderate, while in the latter they are more marked, and have sometimes inundated the wharves along its banks and swept away bridges upon its lower reach within the city of Wilmington.

The water coming from above tidal influence on the Christiana during ordinary stages adds about 4 per cent. to the flood-tide volume which enters at its mouth, and that on the Brandywine adds about 40 per cent. to the flood-tide volume which enters at its mouth, while the entire volume from above tidal influence from both streams is about 10 per cent. of the flood-tide volume which enters the basin. This ratio is founded upon the assumption that the volume added to the flood tide is the entire quantity which flows into the upper ends of the basins during about 12½ hours, or the interval of time covered by one flood and ebb tide.

Above the limits of tidal influence on both the Christiana and Brandywine are numerous dams, which would act as settling basins, except during unusual freshets, thereby depriving the water of any large quantities of sediment.

The following data relating to the physical characteristics of the harbor are mainly compiled from the survey made under the direction of the Commission. In the table which immediately follows a comparison is made between the widths and sections of the Christiana River from surveys made in the years 1835, 1880, and 1890.

Christiana River from mouth to Upper Railroad Bridge.

Localities.	Widths of sections.						Area of sections.					
	Low water.			High water.			Low water.			High water.		
	1835.	1880.	1890.	1835.	1880.	1890.	1835.	1880.	1890.	1835.	1880.	1890.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*
A	435	488	501	879	878	800	4,076	3,673	3,820	8,000	7,780	7,720
B	314	333	311	398	399	388	8,444	2,815	2,760	5,580	5,010	4,860
C	365	336	307	544	412	380	2,870	2,500	2,360	5,600	4,740	4,450
D	......	258	240	......	406	352	....	2,440	2,240	....	4,430	4,250
E	......	310	276	......	482	478	....	2,036	1,760	....	4,410	4,020

In the above table the Christiana River is divided into the following reaches:

Section A includes from mouth of Christiana to mouth of Brandywine.

Section B includes from mouth of Brandywine to Third Street Bridge.

Section C includes from Third Street Bridge to Market Street Bridge.

Section D includes from Market Street Bridge to Delaware and Western Railroad Bridge.

Section E includes from Delaware and Western Railroad Bridge to Wilmington and Northern Railroad Bridge.

The survey of 1835 did not extend above Market Street Bridge, hence comparisons above that point for 1835 are not possible.

Areas of tidal basin.

	Square feet.
From head of basin on Christiana to Wilmington and Northern Railroad Bridge	9,300,000
From Wilmington and Northern Railroad Bridge to the mouth of Brandywine Creek	5,400,000
From head of basin on Brandywine to mouth of Brandywine	3,100,000
From mouth of Brandywine to mouth of Christiana	3,800,000
Total area of tidal basin	21,600,000

Tidal volumes.

		Cubic feet.
From above tidal influence on Christiana		4,000,000
From head of tidal basin on Christiana to Wilmington and Northern Railroad Bridge	44,600,000	
From Wilmington and Northern Railroad Bridge to the mouth of Brandywine	29,600,000	
From head of tidal basin to mouth of Brandywine	16,400,000	
From mouth of Brandywine to mouth of Christiana	19,400,000	
Total flood tide volume		110,000,000
From above tidal influence on Brandywine		6,400,000
Total ebb tide volume		120,400,000

Tidal elements.

Locality.	Distance from mouth of Christiana.	Establishment.		Duration.		Range.
		H. W.	L. W.	Flood.	Ebb.	
	Miles.	*h. m.*	*h. m.*	*h. m.*	*h. m.*	
At mouth of Christiana	0.0	11 55	19 05	5 14	7 10	6.0
At mouth of Brandywine	1.3	11 58	19 12	5 10	7 14	6.0
At Eleventh Street Bridge on Brandywine	2.8	12 11	19 25	5 10	7 14	6.0
At Third Street Bridge on Christiana	1.9	12 07	19 17	5 14	7 10	6.0
At Wilmington and Northern Railroad Bridge on Christiana	3.6	12 17	19 29	5 12	7 12	5.9
At Delaware Railroad Bridge on Christiana	5.1	12 30	19 42	5 12	7 12	5.8
At Newport on Christiana	8.1	13 05	20 05	5 24	7 00	5.8
At head of basin on Christiana	14.0	14 21	21 20	5 25	6 59	4.5

A survey of Brandywine Creek was made in 1883 under the direction of the late Lieut. Col. G. Weitzel, Corps of Engineers, from its mouth to Market Street Bridge, which is practically the extent of tidal influence and the navigable part of the stream. During the survey of 1890 a number of cross sections of the Brandywine were taken, and by a comparison of these cross sections with the survey of 1883 it was determined that no essential change had occurred since 1883, consequently the data furnished by that survey has been used by the Commission in that which follows:

Mean widths and sections of Brandywine Creek.

Localities.	Widths.		Sections.	
	Low water.	High water.	Low water.	High water.
	Feet.	*Feet.*	*Sq. feet.*	*Sq. feet.*
Between mouth of Brandywine and Eleventh Street Bridge	134	275	530	1,760
Between Eleventh Street and Market Street Bridge	200	300	650	2,300

CURRENT OBSERVATIONS AND VELOCITIES.

The mean velocities in the Christiana, as determined by dividing the mean discharge per second by the half-tide area of the sections, gives for the flood tide velocities varying from 0.9 foot to 1 foot per second and for the ebb velocities varying from 0.85 to 0.87 foot per second. The mean velocities in the Brandywine, obtained by a similar method, give flood and ebb-tide velocities of practically the same intensity, those at the mouth being about one-third of a foot, at a point about 1,000 feet above the mouth three-fourths of a foot, and at the middle of the basin one-half of a foot per second.

The highest velocity obtained by mid-depth floats occurred when the flood and ebb were from 1½ to 2½ hours old and were as follows:

Locality of observations.	Maximum flood velocities (feet per second).	Maximum ebb velocities (feet per second).
In Delaware River at mouth of Christiana	2.7	....
In Christiana River at mouth	1.5	1.4
In Christiana River opposite mouth of Brandywine	1.9	1.7
In the mouth of Brandywine	0.6	0.6
In Christiana at upper part of harbor	2.1	1.9

The tidal velocities in Christiana River are about one-half of those found to exist in the Delaware River under similar conditions.

PAST PROJECTS AND WORK DONE FOR THE IMPROVEMENT OF WILMINGTON HARBOR.

In 1836, 1837, and 1838, $32,356 was appropriated for the improvement of Wilmington Harbor. In the working season of 1839, Major Hartman Bache states that 13,518 cubic yards were removed from the Christiana River by dredging. Of this amount 3,505 cubic yards were removed from the bar at the mouth, and the remainder from the 3,500 linear feet of channel directly below Market Street Bridge. The depth of water thus secured enabled a vessel of 16 feet draft to pass out of the river at high water, indicating that there must have been 10 feet in the shoalest part of the channel at low water.

No further improvements were made until appropriations were renewed in 1870, when a project was adopted for the formation by dredging of a channel 120 feet wide and 12 feet deep at mean low water from the mouth to a short distance above Market Street Bridge. Under this project work was carried on until 1880, removing about 246,000 cubic yards of material and giving the channel a depth of 12 feet, with widths varying from 75 to 150 feet.

In 1881 Col. J. N. Macomb expanded the project to include the formation of a channel between the mouth and the Pulp Works from 150 to 75 feet wide and 15 feet deep at mean low water, and a channel 50 feet wide and 12 feet deep from the Pulp Works to the Delaware Railroad Bridge. The project involved the removal of 481,000 cubic yards of dredged material and 438 cubic yards of rock near Third Street Bridge, and the construction of a jetty about 1,800 feet in length at the mouth of the river.

This project was referred to a Board of Engineers, who, while generally concurring with Colonel Macomb in his views that the improvement could be obtained by dredging, did not feel confident that such a channel could be maintained by the erosive action of the currents, but considered that much deepening beyond the natural bed of the stream would be followed in time by a reshoaling of the dredged area. (Report of the Chief of Engineers, 1881, page 777; 1882, page 776.)

Under this project, and up to the close of the working season of 1883, about 158,000 cubic yards of material were removed and the jetty at the mouth was extended to a length of about 1,800 feet.

In 1883, under the recommendation of Lieut. Col. G. Weitzel, the project was further expanded so as to provide for a channel 150 feet wide and 15 feet deep at mean low water, from the mouth to the pulp works. In this modification of the project of 1881, the depth of the proposed channel remained the same, the width only being changed. Subsequently it was proposed to raise the height of the existing jetty and extend it for a farther distance of about 300 feet.

From the adoption of this modified project in 1884 to the close of the past season, about 378,000 cubic yards of material were removed.

The following statement shows the localities and quantities of material removed by dredging from the commencement of the improvement to the close of the season of 1890.

SUMMARY OF DREDGING.

		Cubic yards.	Cubic yards.
1839	From Market Street Bridge to 3,500 feet below	10,013	
	Bar at mouth	3,505	
			* 13,518
1871	From Third Street Bridge to 1,700 feet above From outer bar to 2,700 feet above	39,000	
1873	From mouth of Brandywine to 1,100 feet below	2,900	
	From Third Street Bridge to 1,500 feet above	17,310	
	At and just above Market Street Bridge	3,855	
1876	At outer bar	12,000	
	From Third Street Bridge to 1,200 feet above	14,007	
	Just above Market Street Bridge	4,070	
1877	From mouth to 1,500 feet above	33,000	
	From 1,200 feet below Brandywine to 1,600 feet below	22,000	
	From mouth of Brandywine to 700 feet above Third Street Bridge	26,000	
	From Market Street Bridge to 600 feet above	7,000	
1878	At outer bar	35,630	
1879	From mouth to 1,200 feet above	29,000	
			† 245,772
	Just above mouth Brandywine		
1882	From 500 feet below Third Street Bridge to pulp works	38,290	
	From outer end jetty to 2,500 feet inside	107,006	
1883	From Delaware and Western Railroad to pulp works	12,552	
			‡ 157,848
1885	At outer end of jetty	9,570	
1886	At Market Street Bridge	3,650	
1887	From outer jetty to Market Street bridge	199,898	
1889	From outer end jetty to mouth Brandywine	165,214	
			§ 378,332
	Total removed by dredging		795,470

PRESENT CONDITION OF THE HARBOR.

At the outer end of the jetty there is found a 12-foot channel about 35 feet wide; 250 feet inside the 15-foot channel practically begins and continues to a point about 500 feet below the railroad bridge, or for a distance of 6,500 feet; in this reach the 15-foot channel varies from 50 to 125 feet in width; thence to the mouth of the Brandywine, a distance of 2,000 feet, there is a channel from 12 to 14 feet deep and from 50 to 150 feet wide. Directly opposite the mouth of the Brandywine the 12-foot channel disappears for a short distance, but after being resumed continues for a distance of 3,000 feet with widths varying from 50 to 125 feet; for parts of this distance a narrow 15-foot channel is found. The succeeding 500 feet extends to the Third Street Bridge, and in this reach the channel shoals to a depth of 10 feet with a width of about 125 feet. Above the Third Street Bridge the 12-foot channel is resumed for a distance of 2,000 feet, with a width of from 50 to 100 feet. The succeeding

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* Project, 1839. † Project, 1870. ‡ Project, 1881. § Project, 1883.

2,500 feet extends 500 feet above the Market Street Bridge, and carries a channel 10 feet deep and about 100 feet wide. From thence to the Delaware and Western Railroad Bridge, a distance of 1,500 feet, a 12-foot channel exists from 50 to 100 feet wide. From thence to the pulp works, a distance of 3,000 feet, there is a channel from 8 to 9 feet deep and 50 to 100 feet wide.

By summarizing the foregoing it is found that in the 21,000 feet of channel between the outer end of the jetty and the pulp works there is 6,500 linear feet of 15-foot channel, 2,000 feet of 12 to 14 foot channel, 6,700 feet of 12-foot channel, 3,000 feet of 10-foot channel, and 3,000 feet of from 8 to 9 foot channel.

Disregarding all previous dredging, it is found that in 1882 the 9,000 linear feet of channel between the Third Street Bridge and the pulp works was dredged to a depth of 12 feet. In 1887 the 16,000 linear feet of channel between the outer end of the jetty and Market Street Bridge was dredged to a depth of 15 feet, and in 1889 the 8,700 linear feet of channel between the outer end of the jetty and the mouth of the Brandywine was again dredged to a depth of 15 feet in a channel 150 feet wide.

No improvement of Brandywine Creek has been made by the Government. After passing the bar at its mouth, which carries less than 3 feet depth at mean low water, a channel extends to the head of tidal influence, a distance of about 2 miles, with a low water depth of from 3 to 4 feet, and with a width of from 150 to 75 feet, except at two localities near the head of navigation, where the depth is less than 3 feet.

PLANS OF IMPROVEMENT.

The project of 1883, under which work has been in progress since 1885, proposes the formation by dredging of a channel 15 feet deep at mean low water and 150 feet wide, extending from the jetty at the mouth of the Christiana River to the pulp works, or for a distance of about 4 miles; the maintenance of the channel over the outer bar to be aided by the action of a jetty extending into the Delaware River from the north shore of the Christiana River. This jetty has been built for a length of about 1,800 feet.

The formation of a channel 150 feet wide at the bottom, with side slopes of 1 on 5, would require the removal of 600,000 cubic yards, place measurement, or 720,000 cubic yards, scow measurement, described as follows:

	Cubic yards.
Section A	115,000
Section B	133,000
Section C	206,000
Section D	109,000
Section E	157,000
Total	720,000

This project would further involve the removal of 540 cubic yards of solid rock from an area of 3,200 square feet above Third Street Bridge and an area of of 5,500 square feet below Third Street Bridge.

The estimated cost of this work is as follows:

460,000 cubic yards of mud and sand, at 15 cents	$69,000
260,000 cubic yards of sand and gravel, at 20 cents	52,000
540 cubic yards of rock at $15	8,100
Contingencies	12,900
Total	142,000

The formation of a channel 150 feet wide and 24 feet deep at mean low water from the mouth to the Delaware and Western Railroad Bridge and from thence to the pulp works 20 feet deep would require the removal of the following:

	Cubic yards.
Section A	1,060,000
Section B	610,000
Section C	700,000
Section D	380,000
Section E	340,000
Total	3,090,000

Such a project would involve the removal of 8,300 cubic yards of rock from areas of about 22,000 square feet each above and below Third Street Bridge.

The estimated cost of this work is as follows:

1,670,000 cubic yards of mud and sand, at 15 cents	$250,500
700,000 cubic yards of sand, and gravel, at 20 cents	140,000
720,000 cubic yards of sand and gravel, at 25 cents	180,000
8,300 cubic yards of rock at $15	124,500
Contingencies	69,000
Total	764,000

In the resolutions adopted by the leading commercial interests of Wilmington on February 9, 1891, and submitted to the Commission at their public meeting of February 16, 1891, it was stated that the desired improvement of Wilmington Harbor covered a channel in the Christiana River 300 feet wide and 24 feet deep from the mouth to the Delaware and Western Railroad Bridge, and from thence to the pulp works a channel of the same width and not less than 20 feet deep.

The resolutions further stated that the Brandywine should be improved by the formation of a cut-off through the neck of land near the property of the Jackson-Sharp Company, thereby connecting the Brandywine and Christiana at this point, and the formation of a channel 10 feet deep at mean low water and 150 feet wide from deep water in the Christiana to the Market Street Bridge.

The Commission presents an estimate for the formation by dredging of a channel in the Christiana of the desired depth of 20 and 24 feet, but reduces its width to 150 feet, for reasons given in a subsequent part of this report.

The very small natural capacity of the Brandywine, the presence of large quantities of rock in its bed, and the limited character of its tidal volume, preclude the possibility of any marked improvement of its channel except at a very considerable cost, and without assurance that such an improvement would be permanent. It is quite possible that the formation of the proposed cut-off might be a material improvement, but, when to the previous difficulties are added the complications involved in the opening of a new and the closing of the old mouth of the stream, it seems best, in the judgment of the Commission, to postpone the improvement of the Brandywine (except at the mouth, as proposed in another part of the report), until that part of the harbor covered by the Christiana shall have been improved beyond its present capacity.

MAINTENANCE OF THE CHANNEL.

For reasons which are fully investigated in another part of this report the tidal forces alone, under the present conditions, have not sufficient power to permanently maintain even the existing channel, much less a larger one; as will appear from the following considerations:

The estimate of quantities submitted with the project of 1883 for the formation of a channel 150 feet wide and 15 feet deep from the mouth to the pulp works, required the removal of 445,000 cubic yards of material. If this quantity be assumed as place measurement it is equal to about 535,000 cubic yards scow measurement.

If this latter quantity be reduced by the quantity of material removed by dredging since 1883, there would remain to be removed under the project (535,000—378,000) 157,000 cubic yards. The survey of 1890 shows that 720,000 cubic yards will now require to be removed to form the proposed channels, indicating that there has been a deposit of (720,000—157,000) 563,000 cubic yards since 1883.

Confirmatory conclusions as to the deposition of material in the bed of the river may be also gained by a comparison of the low-water sections of 1835, 1880, and 1890, taken in connection with the dredging done during the intervals 1835 to 1880, and 1880 to 1890, the data for which are given on previous pages.

Between 1835 and 1880 260,000 cubic yards were removed by dredging. By a comparison of the low-water sections of 1835 and 1880 it is found that, even after this quantity of material had been removed, there was a loss of section equivalent to a volume of 280,000 cubic yards in the part of the river between the mouth and Market Street Bridge; indicating that between these dates there had been a shoaling of 540,000 cubic yards.

Between 1880 and 1890 536,000 cubic yards were removed by dredging. A comparison of the low-water sections of 1880 and 1890 shows that after the removal of this quantity of material there was still a loss of volume equal to 35,000 cubic yards. Hence between these dates there must have been shoaling to the extent of about 570,000 cubic yards.

These comparisons indicate that between 1835 and 1890 there had been deposited in the bed of the river about 1,100,000 cubic yards of material, of which 800,000 cubic yards had been removed by dredging, leaving at this date about 300,000 cubic yards yet to be removed to restore the river to the condition of 1835. This loss of sectional area is indicated in the table given on a previous page.

The area of the river bed between the inner end of the jetty and the pulp works is about 800,000 square yards. If the before-mentioned 1,100,000 cubic yards of estimated deposit be applied uniformly to this area it will represent a depth of about 4 feet.

Available surveys are too far apart to permit any very definite conclusions as to the annual rate of shoaling; it is probable that the rate is far from constant, but rather dependent upon the yearly amount of dredging.

On the section between the mouth and the Brandywine, a distance of about 7,000 feet, there was removed by dredging between 1882 and 1890 about 380,000 cubic yards. This resulted in a gain equal to about 35,000 cubic yards of volume, leaving a balance of 345,000 cubic yards to be accounted for as the result of shoaling, or an average annual deposit of about 40,000 cubic yards.

Between August and December, 1889, 165,000 cubic yards were removed between the outer end of the jetty and the mouth of the Brandywine in the formation of a channel 150 feet wide and 15 feet deep. The survey made in December, 1890, shows that 115,000 cubic yards would require to be removed at the latter date to form a channel of the above dimensions between the points named. This would indicate a shoaling of 115,000 cubic yards between December, 1889, and December, 1890.

Since the length of the reach of river between the mouth of the Christiana and the junction of the Brandywine is about one-third of the distance between the mouth and the pulp works, it might be assumed from these latter determinations that the annual rate of shoaling would be from 120,000 to 150,000 cubic yards. Such a conclusion would only be justified on the assumption that all parts of the improved channel possess equal ability to maintain an improved channel of the dimensions named; that such is not the case must be inferred from the following:

After the formation of such a channel the ability of the river to maintain the improved section at any point would be dependent upon the tidal velocities, or, in other words, upon the tidal volume passing that point.

The following table shows the present relation between the ebb-tide volumes passing the middle point of the several reaches of the river and the mean low-water cross section of these reaches:

Localities.	Ebb-tide volumes.	Mean low-water cross section.	Ratios.	
			Tidal volumes.	Low-water sections.
	Cu. feet.	*Sq. feet.*		
Section A	111,000,000	3,920	1.00	1.00
Section B	74,000,000	2,760	.67	.70
Section C	65,000,000	2,360	.58	.60
Section D	59,000,000	2,240	.53	.57
Section E	54,000,000	1,760	.48	.45

The nearly similar ratios between tidal volumes and low-water sections in the preceding table clearly indicate the existing relation between present tidal volumes and cross sections, and permits the assumption that, while other conditions remain unchanged, any increase of the latter without a corresponding increase of the former would not be permanent.

Since the tidal volume is measured directly by the product of the area of the basin by the range of the tide over that area, it follows that no increase of tidal volume can be obtained without increasing one or both of these factors. The simple increase of channel depths by dredging will not add to the area of the basin, and since the present range of the tide is equal for all parts of the basin between the mouth and Newport, a distance of 8 miles, but little can be anticipated in the way of increased range.

The formation of a 15-foot channel 150 feet wide would increase the existing low-water cross section to the following:

Localities.	Present section.	Increase.	Improved section.	Ratios.		
				Present.	New.	Present to new.
	Sq. feet.	*Sq. feet.*	*Sq. feet.*			
Section A	3,920	280	4,200	1.00	1.00	1:1.07
Section B	2,760	800	3,560	.70	.85	1:1.29
Section C	2,360	1,200	3,560	.58	.85	1:1.50
Section D	2,240	1,020	3,260	.53	.78	1:1.45
Section E	1,760	1,428	3,188	.48	.76	1:1.84

If the existing sections be assumed to be in adjustment with the tidal forces passing through them, it will be seen from the above table that to maintain the improved sections these tidal forces would have to be increased 7 per cent. on the lower, 50 per cent. on the middle, and 84 per cent. on the upper reach. Without such an increase in the maintaining power of the river the rate of shoaling would be greatly increased beyond that which now exists, and consequently any estimate based on the present rate of shoaling, as from 120,000 to 150,000 cubic yards per annum, would be entirely too small.

The formation of a 24-foot channel 150 feet wide from the mouth to the Delaware and Western Railroad Bridge, and from there to the pulp works a channel of the same width and 20 feet deep, would increase the existing low-water cross section to the following:

Localities.	Existing section.	Increase.	Resulting section.	Ratios.		
				Present	New.	Present to new.
	Sq. feet.	*Sq. feet.*	*Sq. feet.*			
Section A	3,920	2,870	6,790	1.00	1.00	1:1.73
Section B	2,760	3,800	6,560	.70	.91	1:2.38
Section C	2,360	4,130	6,490	.58	.90	1:2.70
Section D	2,240	3,530	5,770	.53	.85	1:2.58
Section E	1,760	2,920	4,710	.48	.70	1:2.74

It will be seen from the foregoing that to maintain a channel of the above dimensions the tidal forces would require to be increased 73 per cent. in the lower and about 170 per cent. in the middle and upper reaches of the proposed improvement.

The methods available for maintaining, or partly maintaining, the channel volume are as follows:

1. The supply of material for shoaling may be cut off or diminished, thus reducing the work imposed upon the tidal forces.
2. The channel may be rectified so as to remove or modify the causes which produce local changes of velocity and thus induce deposits.
3. The working power of the tidal forces may be increased by an increase of the tidal volume.
4. The scouring power of the tidal forces may be increased by increasing the maximum tidal velocities.
5. The material deposited may be mechanically removed by dredging.

1. *Sources of material.*—The material deposited in the channel is brought down in suspension by the backwater carried in from the Delaware by the flood currents or supplied by scour or the introduction of sewage and drainage within the limits of the tidal basin. In order to determine the relative importance of these sources in the supply of material, observations were made at the mouth, Third Street Bridge, and pulp works by taking one quart of water from points respectively 1 foot above the bottom and 4 feet below the surface at intervals of 1 hour from the beginning of the flood to the end of the ebb. The relative volumes of sediment thus obtained are shown on the diagram herewith.

A study of totals of the sediment observations seems to justify the following conclusions:

1. The sediment moving near the bottom on the ebb increases from the pulp works towards the mouth. This indicates a source of supply between the pulp works and the mouth.
2. The sediment moving near the surface on the ebb increases from

the pulp works to the Third Street Bridge and decreases from the bridge to the mouth. This indicates that the increase at the mouth is partly due to settlement and the increase at Third Street Bridge is in a greater degree due to scour or to the introduction of new material.

3. The sediment moving near the bottom on the flood decreases from the mouth to Third Street Bridge and increases from the bridge to the pulp works. This indicates two sources of supply, one at the mouth and one between the bridge and the pulp works.

4. The sediment moving near the surface on the flood increases from the mouth to the pulp works. This indicates that the increase is principally due to scour all the way up.

5. At the pulp works near the bottom the ebb sediment is very much less than the flood sediment; near the surface it is about the same, being a little greater on the ebb than on the flood. This indicates that the principal source of supply is below the works and that there is no deposit, but possibly a little scour on the ebb.

6. At the other stations the ebb sediment was greatly in excess of the flood near both bottom and surface. This indicates a continuous supply of material in the channel from sources between the pulp works and the mouth.

A study of the detailed observations seems to justify the following conclusions:

1. In general the changes in the amount of sediment near the surface are slight compared with the changes near the bottom. This indicates that the principal cause of change is scour or the introduction of material at a low level which does not rise near the surface.

2. At 1 hour after low water (as shown by the bottom observations) there is a large increase of sediment at the mouth, a diminution of sediment between the mouth and the bridge, and an increase of sediment from the bridge to the pulp works. Near the surface the sediment increases to the bridge and remains constant from the bridge to the works. This indicates a scour at the mouth near the beginning of the flood current, a deposit in the reach below the bridge, and a supply of new material at a low level between the bridge and the pulp works.

At 2 hours after low water the sediment at the mouth has much diminished, being the same as it was at low water. It remains constant to the bridge, but increases to a maximum at the pulp works. Apparently the deposit below the bridge has ceased, but the addition of material above the bridge has increased.

At 3 hours after low water the conditions at the mouth and bridge are practically the same as at 2 hours. The increase at the pulp works continues, but in a less degree. For the remaining hours of the flood the variations of sediment are not significant.

Two sources of supply are indicated, one at the mouth at 1 hour after low water, and the other between the bridge and the pulp works at 1, 2, and 3 hours after low water.

3. At 1 hour after high water there is a slight increase of sediment at the pulp works. At all the other hours of the ebb the sediment is practically constant. Probably at the turn of the tide there is a slight scour of material deposited during the flood.

At 1 hour after high water the sediment increases slightly, but uniformly, from the pulp works to the mouth.

At 2 hours after high water the rate of increase is greater from the pulp works to the bridge and very much greater from the bridge to the mouth. There is evidently scour between the bridge and the mouth.

At 3 hours after high water the rate of increase is greater between the pulp works and the bridge and still greater between the bridge and the mouth, where the sediment reaches its maximum. The scour thus indicated below the bridge is probably the removal of a portion of the material deposited during the first hours of the flood and the last hours of the ebb.

At 4, 5, and 6 hours after high water the increase between the pulp works and bridge attains its maximum and the sediment decreases from the bridge to its normal value at the mouth. There is evidently addition of material between the pulp works and the bridge and deposits between the bridge and the mouth.

A comparison of the sediment obtained in the flood observations with that obtained in the ebb observations shows that the former is heavier material than the latter, settling much more rapidly after agitation.

While the observations do not furnish the data necessary to determine with any degree of accuracy the relative influence of the two sources in furnishing material for shoaling, the changes in sediment density are so much greater between the pulp works and the Third Street Bridge than between the bridge and the mouth as to indicate that an important source of sediment is the sewage and drainage of the city of Wilmington.

These conclusions may be summarized as follows:

1. The material brought down in suspension by the fresh water at ordinary stages of the river is relatively insignificant, producing no changes of density, and need not be considered in plans for improvement.

2. The material brought in from the Delaware by the flood current is introduced in the greatest quantity at the early stages of the flood. Some of this material is deposited in the channel below the Third Street Bridge, probably on the bar opposite the mouth of the Brandywine.

3. A considerable part of the material supplied between the Third Street Bridge and the pulp works is introduced into the river through the sewers and drains of the city of Wilmington. Some of it is alternately deposited upon and scoured from the shoal near the mouth of the Brandywine. It should not be inferred, however, that this source of supply will account for the principal part of the large deposit indicated by data previously given. Wilmington has a population of about 60,000, and upon the most liberal estimate the solid material supplied by its sewage could not exceed 20 tons per day, while the rate of shoaling appears to be ten times as great. Doubtless the supply is very largely increased by drainage, but this can hardly account for the difference. All that can safely be inferred is that these elements are important sources of supply.

The material brought down in suspension by the waters of the Brandywine has generally been supposed to form an important part of the supply for shoaling in the Christiana, but the studies of the Commission do not confirm this conclusion. The observed permanency of the channel sections in the Brandywine indicates the presence of little material for deposit during ordinary stages. Most of the material transported is brought down during the freshets, when the currents are sufficiently powerful to remove it.

The material brought into the river at its mouth can not be excluded or its amount diminished by any method of improvement. It is a necessary incident to the introduction of water from the Delaware, which carries considerable sediment in this vicinity.

The material introduced through the sewers of Wilmington can be completely excluded by carrying it in an intercepting sewer directly to the Delaware.

The following information relating to the drainage of the city of Wilmington, which is of great interest in this connection, was furnished by Mr. T. C. Hatton, engineer in charge of sewers.

Area of city surfaces draining into Christiana River, 3,260 acres; area draining into Brandywine Creek, 871 acres. The number and sizes of sewer outlets into the Christiana are as follows: One 12-inch, two 15-inch, one 20-inch, one 22-inch, one 30-inch, one 3 by 4 inch, one 4 by 5 inch, one 5 by 6 inch, and one 6 by 6 inch.

The sewers discharging into the Brandywine are one 10-inch, two 12-inch, one 20-inch, two 24-inch, one 30-inch, two 36-inch, and one 10 by 12 inch.

It was the practice in the past to permit all drainage from street surfaces to be carried into the sewers and discharged into the Christiana and Brandywine, but methods are now being introduced by which a part of the heavier deposits is arrested by catch basins. It is further stated that a comprehensive system of drainage is now in process of construction by which all sewage is to be taken by an intercepting sewer directly to the Delaware River, while the rainfall is to be discharged into the Christiana and Brandywine at the several city wharves.

Mill Creek, which joins the Christiana near the pulp works, drains, superficially, quite a large area, of which but a small part is within the corporate limits of the city. In the revised plan before mentioned, it is proposed to utilize this affluent for the drainage of a considerable area.

2. *Rectification of the channel.*—The observations of the Commission establish the interesting fact that there is little or no deformation of the tide wave in its passage over that portion of the river where improvement is desired. Gauges connected by accurate levels were observed at three points at each hour of the tide, and the surface slope at each hour was thus determined. The variations of these slopes, as shown on the accompanying diagrams, are so small that it may be concluded that the ebb and flood are very little impeded, since obstructions to the movement of tide water always produce local changes of level. This conclusion is further confirmed by the small and uniform tidal retardations shown in the table of tidal elements.

Within the limits of the improvement desired, the principal points at which abnormal shoaling exists are at the four bridges, the entrance of the Brandywine, and the mouth of the Christiana.

The four bridges have each a single pier in the channel. Such obstacles can not fail to increase the tendency of the stream to deposit material in the channel, and the evidence of this influence is clearly shown by the survey and by the results of temporary improvements. The bridges have been carefully examined to determine whether there are defects of location or construction the correction of which would improve the local conditions. With the exception of the lower bridge, the pile bents of which are perpendicular to its axis instead of parallel to the axis of the draw-span pier and direction of the flood and ebb currents, as they should have been to offer the minimum obstruction to the currents, the bridges have no objectional features. The defect in the lower bridge is not considered sufficiently serious to justify the requirement of its reconstruction. So far as its effect upon the channel is concerned the location of the pier can not be improved.

As previously stated, the Commission is of the opinion that the improvement of the Brandywine should be deferred for the present; but e conditions existing at its junction with the Christiana justify its ctification in that locality, since the present direction of confluence, ing almost at right angles with the Christiana, is prejudicial to the aintenance of an improved channel in the latter river.

The current observations made at the junction of these streams show at the ebb in the Christiana runs close in upon the left bank both ove and below the junction of the Brandywine, while, in the latter ream, the ebb is concentrated around the lower angle at the mouth, ereby causing the confluent currents to move entirely to the left of e natural deep-water channel in the Christiana. During the flood tide e current in the Christiana coincides with its thalweg, with barely rceptible velocities entering the mouth of the Brandywine.

To cause the flood and ebb currents of the Christiana to follow more arly along the same path at this locality, and to diminish the disturbce produced by the introduction of the waters of the Brandywine, a gh-water dike is required extending from the upper angle of the juncon of the two streams for a distance of about 600 feet and in a direcon nearly parallel with the channel of the Christiana. As compensaon at the mouth of the Brandywine for the interference of such a dike d also to improve the alignment of the modified entrance, the shore e at the lower side should be rounded off by moving the land dike ck for a distance of about 100 feet at the angle, and the low-water idth correspondingly widened by dredging.

The estimated cost of this rectification at the mouth of the Brandyine is $20,000.

The full discussion of the problem of rectification as it is presented at e mouth of the river requires an examination of the work of improveent already constructed and the physical conditions as they now exist this locality.

Previous to improvement the bar in the Delaware opposite the mouth the Christiana River carried a low-water depth of from 8 to 9 feet. e jetty on the north side of the entrance, extending from Light-House oint for a distance of 1,750 feet, was constructed between the years 82 and 1885. It had for its object the maintenance of a 15-foot lowater channel to be formed by dredging.

A comparison of the chart of the recent survey with charts existing efore the construction of the jetty shows that the currents of the Delare have sufficient power to overcome the tendency to shoal at the d of the jetty, the position of the 15-foot curve remaining practically changed. The jetty is, however, unable to maintain a channel of equate width and depth. Such a channel has been repeatedly formed dredging, but it is invariably filled by shoaling, except for a narrow ace in the immediate vicinity of the work.

This jetty was intended "to control and direct the Christiana ebb d protect it from the greater volume of the Delaware currents witht injurious interference with the free admission of the flood tide." It doubtedly does direct the ebb currents of the Christiana and protects em from dispersion by the currents of the Delaware; but, at the same me, it prevents the removal of deposited material by the latter curnts, and the waters of the Christiana, after passing the natural gorge, read out to the southward without restraint, their power of channel aintenance being thus dissipated.

The Commission is of the opinion that the best remedy for this diffilty is the construction of a jetty on the south side of the entrance to event the dispersion of the ebb water of the Christiana, located as own on the accompanying map. The jetty may be of earth faced with stone, from the shore outward for a distance of about 1,400 feet. The remaining portion for a distance of about 1,200 feet should be a pile dike filled with stone, like those now in process of construction in the Delaware River. The distance between the jetties at their outer ends is taken at 500 feet.

The cost of this work is estimated at $30,000. With the improved channel this will give a cross section greater than the theoretical normal area, so that there will be no injurious interference with the free admission of the flood tide. Since no deposit is to be anticipated at the end of the jetties, the Commission believes that a permanent low-water channel having a depth of 15 feet can thus be obtained.

Should a channel having a depth of 24 feet be formed at the mouth, it would be necessary to extend jetties into the Delaware River beyond their ends in the 15-foot project for an aggregate distance of about 5,000 feet, whatever methods of removing the deposits might be adopted, at an estimated additional cost of about $175,000. Such an extension, however, could not be made without danger of serious interference with the maintenance of the main ship-channel dredged by the Government through Cherry Island Flats in the Delaware River.

It has been generally supposed that a large amount of the material forming shoals is supplied from the foreshore between the high and low water lines, but the examinations of the commission do not confirm this conclusion. The material derived from this locality is principally due to the undercutting of the banks by the wash of steamboat waves. This supply could, of course, be cut off by protecting the shores at all places where permanent wharves are not erected, as suggested in the resolutions adopted at the Wilmington meeting, but the amount is not sufficient to justify the expense. It will be much more economical to remove this material by dredging.

Should the systematic rectification of the Christiana River be undertaken, it would be necessary to establish the harbor lines to some point above the city of Wilmington in accordance with the adopted project of improvement, but the location of such lines is not a part of the duty of this Commission. The survey of the Commission has been connected with permanent monuments along the crests of the dikes, so that such lines can be readily established when desired.

3. *Increase of tidal volume.*—The ebb-tide velocities may be increased, so as to enable the tidal forces to remove material deposited in the river by sufficiently increasing the tidal volume, and this may be accomplished by the formation of an artificial tidal basin above the reach to be improved.

A tidal basin of sufficient capacity to furnish the necessary increased tidal volume could be formed on the meadow or marsh adjacent to the upper part of the improved channel by inclosing a suitable area with an embankment, connecting such a basin with the river, and dredging it to the required depth.

The general elevation of this marsh land is about 3 feet above mean low water. Although any depth below the plane of mean low water would not be available for increased tidal volume to the river, it would be necessary to dredge it to a depth of about 6 feet below mean low water to permit the use of dredges, scows, and tugs if the material was to be removed by scows. Such a basin would shoal by the deposition of silt brought in by the flood tide, but its depth below the plane of low water could be utilized for such deposits until they encroached upon its tidal capacity, when the basin would again require to be deepened.

If the existing tidal volumes passing through the several reaches be-

ween the mouth and the pulp works be increased in proportion to the
crease of cross sections resulting from the formation of a channel
15 feet deep and 150 feet wide, as shown previously, there would re-
quire to be added the following tidal volumes:

	Cubic feet.
ction A	8,000,000
ction B	22,000,000
ction C	33,000,000
ction D	27,000,000
ction E	45,000,000

If the increased volume of 45,000,000 cubic feet required by the upper
ach be added to the existing volumes, it would be a quantity in ex-
ss of the volumes required in the lower reaches; but since the exist-
g sections indicate a tendency to shoal under the action of the present
dal forces it follows that to produce velocities capable of maintaining
e increased sections it will be necessary to somewhat increase present
locities through these sections.

Assuming that 55,000,000 cubic feet is to be added to the present tidal
lumes by an artificial tidal basin and that the range of the tide in
ch a basin will be 6 feet, the basin would require an area of about
160,000 square feet, or about 200 acres.

The formation of such a basin by dredging and removal of the ma-
rial in scows would involve the removal of about 3,000,000 cubic
rds of material. If the material could be removed by sluicing it over
w areas adjacent to the basin, the depth of excavation could be re-
ced to 6 feet and the quantity of material to be removed to about
000,000 cubic yards.

The cost of the formation of such a basin, exclusive of the value of
e land required, would be about $450,000.

If the formation of a tidal basin be applied to the maintenance of a
annel 150 feet wide and 24 feet deep between the mouth and the
laware and Western Railroad Bridge, and thence to the pulp works
channel 20 feet deep at mean low water, there would be required,
the assumptions made in the case of the 15-foot channel, the follow-
g increase of tidal volumes:

	Cubic feet.
ction A	81,000,000
ction B	102,000,000
ction C	110,000,000
ction D	93,000,000
ction E	94,000,000

Assuming that 130,000,000 cubic feet would have to be added to the
isting tidal volumes to maintain the increased sections, a basin would
required with an area of 21,600,000 square feet, or about 500 acres.

The formation of such a basin would require the removal of about
200,000 cubic yards of material, if removed in scows, or about 5,000,000
bic yards, if sluiced over adjacent low areas. The cost of such a
sin, exclusive of the value of the land, would be about $1,100,000.

With basins of the capacity above described, the tidal volumes pass-
g through the improved sections would increase the mean velocities
the ebb through the existing sections about 50 per cent., or to about
feet per second.

If such a method should be used in the improvement of Christiana
ver, the formation of the tidal basin should precede the formation of
e dredged channels, both for the purpose of aiding in their initial for-
ation and preventing the deposit of material in the enlarged sections
the river.

Current velocities in such basins would be very slight except at its point of junction with the river; consequently the deposition of sediment in the basin might be quite rapid and the maintenance of its capacity would have to be secured by dredging.

4. *Flushing tidal reservoir.*—The principle upon which the action of a flushing tidal reservoir would be based is as follows: The tidal velocities of both flow and ebb, starting from a position of rest, reach their maximum in about 1 hour; such velocities then continue with but small change to within about 1 hour of their end, when they decrease to zero.

The valuable working power of the tidal currents to produce scour or to maintain the channels in which they move occurs during the period of their maximum velocity. If this is less than what may be called the effective velocity, neither the material forming the bed of the stream nor the material brought into the stream from outside forces can be moved, and deposition will ensue.

If a part of the flood-tide volume could be impounded and held back for a time from its normal discharge on the ebb, and when released the interval of its discharge reduced to a shorter time than would otherwise have obtained, there would result an increased ebb velocity during the interval of such discharge. By establishing a proper relation between the impounded volume and the interval of its action when released, velocities could be induced which would be higher than the normal velocities of the ebb. Such an application of a part of the ebb tide volume would practically convert it into a flushing force, by means of which the improved channel could be swept at as frequent intervals and by as high velocities as were found from experience to be necessary.

The application of this method to the securing of higher ebb-tide velocities than would result from the normal action of the ebb would require a movable dam or weir across the river at a point directly above the part to be improved, so arranged as to freely admit the passage of the flood volume into that part of the basin above, and capable of being closed at the time of high water, thereby impounding the flood-tide volume above it. After the tidal volume below the dam had partly passed out, the impounded water would be released and by its flushing action made to sweep from the improved section the material brought in by the flood tide or from other sources.

The volume of the flood tide passing above the pulp works, augmented by the volume coming from above tidal influence, is about 48,000,000 cubic feet; this represents the volume which could be temporarily impounded in the basin above the pulp works.

The flood-tide volume below the pulp works, increased by the back water of the Brandywine, is about 72,000,000 cubic feet and is divided as follows:

	Cubic feet.
Section A	42,200,000
Section B	8,700,000
Section C	8,500,000
Section D	3,900,000
Section E	8,500,000

The average volume passing the middle point of each of the above sections of the ebb tide is as follows:

Section A	50,700,000, or	8,450,000	cubic feet per hour.
Section B	25,250,000, or	4,210,000	do.
Section C	16,650,000, or	2,770,000	do.
Section D	10,450,000, or	1,740,000	do.
Section E	4,250,000, or,	700,000	do.

To increase these latter volumes so as to produce a mean velocity such as was assumed under the action of the tidal basin, viz, 1⅓ feet per second through the enlarged sections for a 15-foot channel, would require the addition of 15,000,000 cubic feet per hour from the impounded volume. Such a supply could be maintained from the reservoir for about 3 hours. If it became necessary to increase the mean velocity to 2 feet per second, 25,000,000 cubic feet per hour would be required, or the capacity of the reservoir for about 2 hours. The application of the same method to the creation of mean velocities of 1⅓ feet per second through the cross-sections which would result from the formation of a channel 150 feet wide and 24 feet deep from the mouth to the Delaware and Western Railroad Bridge and thence to the pulp works, a channel 20 feet deep, would require the addition of 27,000,000 cubic feet per hour from the impounded volume. Such a discharge could be maintained from the reservoir for nearly 2 hours. If it became necessary to increase the mean velocity to 2 feet per second, 45,000,000 cubic feet per hour would be required; the capacity of the reservoir would supply such a discharge for a little more than 1 hour.

The Commission have considered the application of the above-described method to the maintenance of an improved channel between the pulp works and the mouth of the Christiana by the construction of a movable dam or weir across the river at a point about 1,600 feet above the pulp works, or about 600 feet above the Wilmington and Northern Railroad Bridge. The borings made in this vicinity indicate that a bed of gravel suitable for the foundation of the weir is found at a depth of from 12 to 15 feet below mean low water below this locality; stable foundations can not be found at a depth of less than 20 or 25 feet below mean low water.

The plan considered by the Commission involves the construction of about 300 linear feet of movable dam on the Caméré system, with a lock 150 feet long and 30 feet wide, for the passage of the small number of vessels using the river above the weir. The estimated cost of this work is about $200,000. Since the necessity for such a construction is not yet considered by the Commission as demonstrated, the details of construction have been studied only so far as was necessary for the demonstration of its feasibility, and for the formation of an approximate estimate of its cost.

5. *Maintenance by dredging.*—The marked improvements made during recent years in dredging machinery have rendered it economically practicable, in many cases, to maintain by dredging channel dimensions much greater than the normal dimensions for the currents passing through them. Perhaps the most familiar instance is that of the river Clyde, reference to which was made at the public meeting held by the Commision at Wilmington.

This river was, before improvement, a small stream obstructed by shoals. Between Glasgow and the mouth, according to Smeaton's report, there was a minimum depth of 1 foot and 3 inches. At the present time, the navigable channel up to Glasgow, a distance of about 18 miles, has a depth of from 18 to 20 feet at low water and from 28 to 30 feet at high water. These increased depths have been obtained progressively, the low water depth at Glasgow being 8 feet in 1836 and from 12 to 16 feet in 1876.

The history of this improvement presents a series of costly constructions, carried out under the direction of eminent engineers to direct and intensify the action of the natural forces of the river, most of which cannot be considered to have proved of permanent value. By a final resort to dredging on an extensive scale, an artificial channel has bee formed, and is now maintained. From information courteously furnishe the Commission by Mr. James Deas, engineer of the Clyde navigation and from other sources, it appears that, in carrying out this improvement, 35,419,022 cubic yards of material have been removed by dredging. During the last 20 years about 1,250,000 cubic yards per annum have been removed, about one-third of which has been deposited material. During the last 14 years, the cost has been about 15 cents pe cubic yard. The total expenditure for dredging has been about $5,320,00 all of which has been raised by rates and duties laid upon the loca commerce. It has been remarked that "considering the large proportion of deposit to new material dredged out of the Clyde * * * i seemed that very much was required to be done before the Clyde coul be considered a satisfactory instance of engineering skill assistin nature to improve a navigable river." The great commercial benefit which have resulted to the city of Glasgow fully justify the improvement, even by such expensive methods, but it is doubted whether i ever could have been properly carried out at the expense of the genera government.

A navigable channel in the Christiana River, with dimensions fa beyond the normal ones, such as is desired by the business interests o Wilmington, can without doubt be formed and maintained by th methods employed upon the Clyde. The cost of its maintenance b dredging would be heavy, but it can only be determined by actual experience, as it has been determined on the Clyde.

Should the Christiana River be rectified and the supply of sewag cut off by the methods before discussed, it is quite possible that th deposit in a channel of moderate dimensions would be so much reduced that its annual removal by dredging would be more economical than the construction of works for the increase of velocities, but this question can only be definitely decided after the new conditions have been fully established.

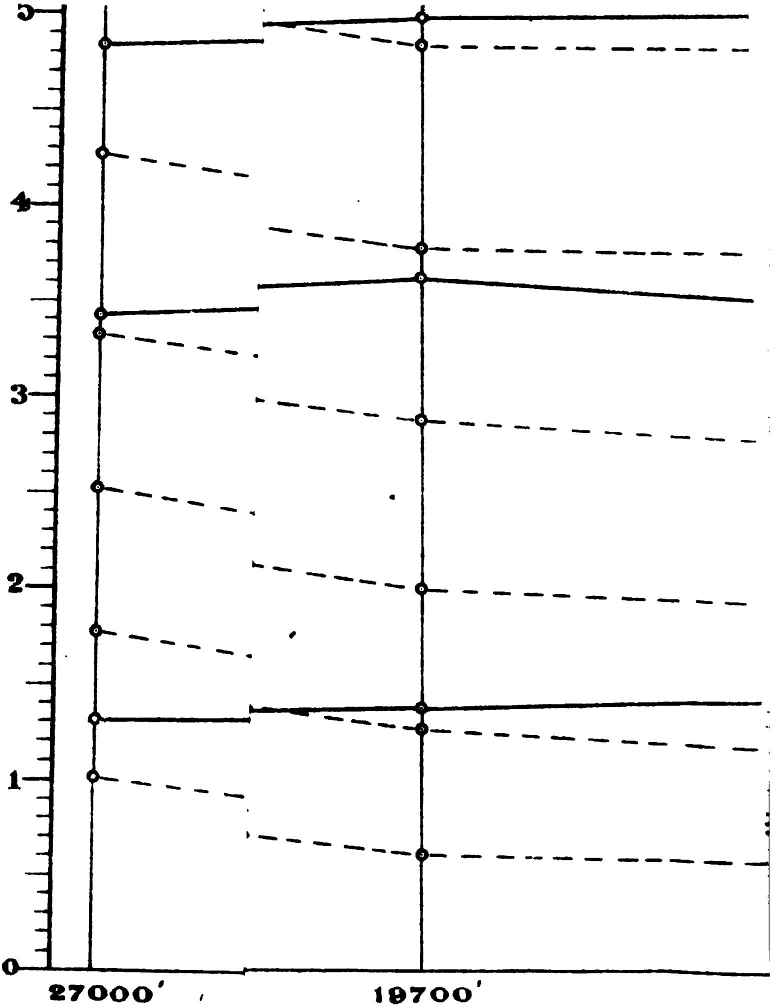
RECOMMENDATIONS.

In conclusion, the Commission has the honor to submit the following plan for the permanent improvement of the harbor to suit the present and prospective wants of commerce and navigation:

1. The comprehensive system of drainage and sewerage now in process of construction by the city of Wilmington should be completed so that no solid material shall be discharged into the Christiana River through drains or sewers, thereby removing one important source of deterioration. Until this system has progressed sufficiently to insure its early completion large expenditures for the increase of channel dimensions by dredging are considered inadvisable.

2. The channel at the mouth of the river should be rectified by the construction of a jetty on the south side of the entrance, located as shown on the accompanying map. The upper surface of this jetty should be about 2 feet above mean high water. It should be formed of earth, faced with stone, for a distance of about 1,400 feet outward from the shore. For the remaining distance of about 1,200 feet it should be a pile and stone dike, similar to those in process of construction in the Delaware River. The cost of this work is estimated at $30,000.

3. The channel at the junction of the Christiana and Brandywine should be rectified by the construction of a high-water dike about 600 feet in length on the upper side, by moving back the land dike on the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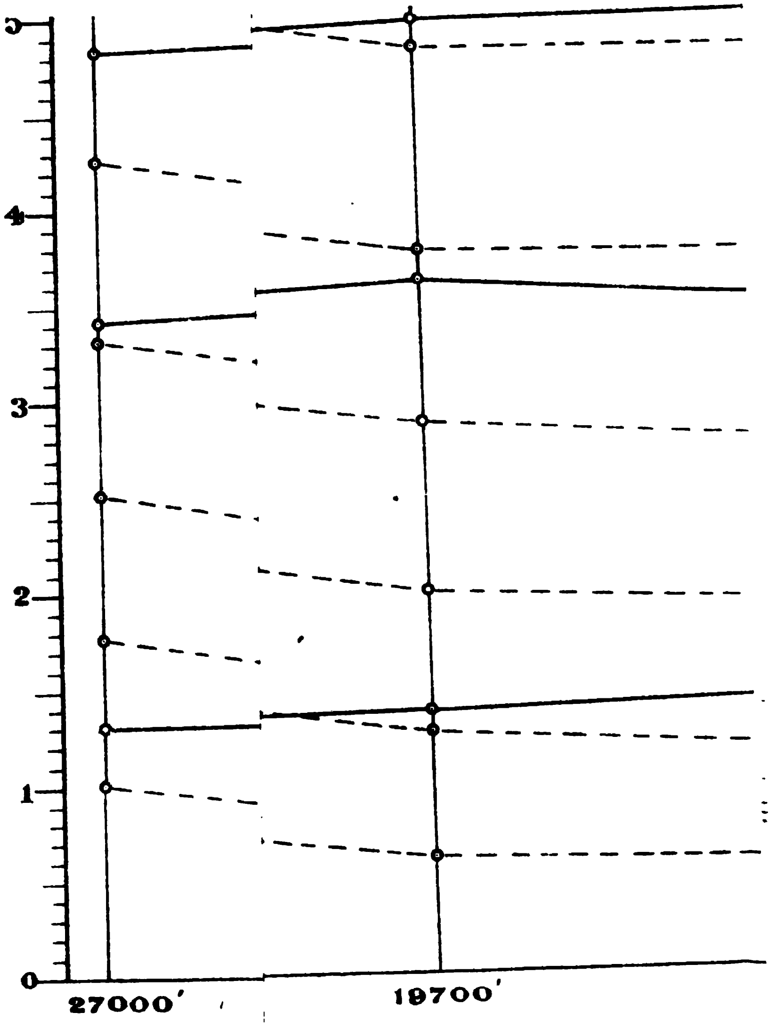
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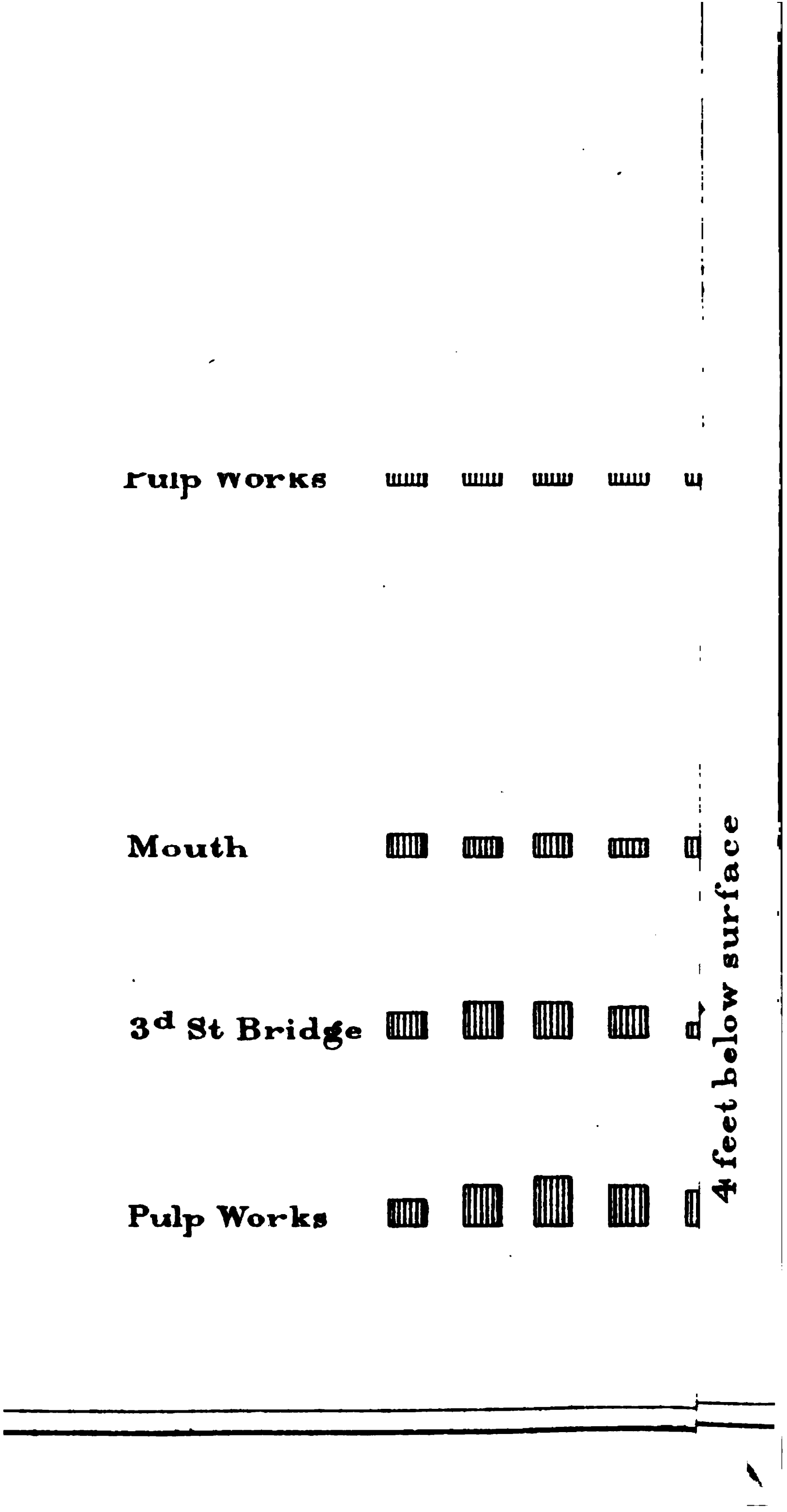
Pulp Works
Mouth
3d St Bridge
Pulp Works
4 feet below surface

lower side for a distance of about 100 feet, and by increasing the low-water width of the mouth of the Brandywine by dredging, as shown on the accompanying map. The cost of this work is estimated at $20,000.

4. When the reconstruction of the drainage system has been carried to such a point as to justify the commencement of dredging, a channel should be excavated from the mouth to the pulp works, having a minimum width at bottom of 150 feet and a depth of 15 feet at mean low water, as provided in the existing project. This will require the removal of about 720,000 cubic yards of sand, mud, and gravel, and about 540 yards of solid rock, and is estimated to cost $142,000. If shoaling occurs during the progress of the work, the estimate must be increased accordingly.

5. When the work above provided for has been completed, careful observations should be made, covering a period of at least 1 year, to determine the rate of shoaling at various points in the channel. From these observations the question can be decided whether it is more economical to maintain the channel by dredging or by the construction of a flushing reservoir. The cost of such a reservoir is estimated at $200,000.

The total estimated cost of the improvement recommended is, exclusive of the flushing reservoir, $192,000, and including the reservoir, $392,000. This estimate does not include the cost of removing material deposited during the progress of the work or the cost of maintaining by dredging.

While the Commission believes the project should not be extended at the present time, beyond the above recommendations, it is of the opinion that a considerable extension of the limits of the improvement may be found practicable and advisable in the future. The problem of tidal river improvement is of such complexity that it is impossible to foresee results with accuracy, except during the progress of the work, and it is therefore desirable to keep the project well within the range of reasonable prediction. The best method of procedure is the progressive method of deepening followed in the improvement of the Clyde. Accordingly the Commission recommends that the improvement of Brandywine Creek and the more extensive improvement of the Christiana River, to meet the prospective wants of commerce and navigation, be left for future consideration.

The following are transmitted herewith:

(1) Map of Wilmington Harbor, Delaware, in three sheets.
(2) Sketch of Wilmington Harbor, Delaware.
(3) Diagram of flood and ebb surface slopes.
(4) Diagram of sediment observations.
(5) Copy of resolutions adopted at a meeting of commercial interests of the city of Wilmington, Del.*

Respectfully submitted.

D. C. Houston,
Colonel of Engineers.
C. W. Raymond,
Major, Corps of Engineers.
L. Y. Schermerhorn,
Civil Engineer.

The Secretary of War.
(Through the Chief of Engineers, U. S. A.)

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*Not submitted.

H 2.

ICE-HARBOR AT NEW CASTLE, DELAWARE.

The river and harbor act of September 19, 1890, appropriated $8,10 for this harbor. This amount, together with the balance available of a former appropriation, is sufficient to complete the approved project, which is to rebuild pier H.

Studies for the removal of pier H and to construct a new one at another point, of reduced dimensions, have been made and the plans were submitted. When these are approved, steps will be taken for an early construction of the pier so as to have it completed before the coming winter.

The project for the establishment of an ice-harbor at New Castle dates back to colonial times and was suggested by the necessity of providing a place of refuge for vessels during the prevalence of ice in the Delaware River. Since the ice-harbor at Reedy Island, 10 miles farther down the river, has become useless, this harbor is now the first one reached by vessels coming up the bay. The number of vessels seeking refuge her during the winter is very great and the enlargement of the harbor i only a question of time. Attention was called in last year's report to th practicability of materially enlarging the area of the harbor by the construction of an additional pier on the 30-foot contour at the point o intersection of two lines prolonged in an offshore direction over piers K and M and L and N, respectively.

The alteration of a large private wharf within the ice-harbor, recently commenced by the owner, has made it imperative, in view of similar changes likely to occur in the future, to preserve the present area of the harbor by the establishment of harbor lines. A recommendation for the adoption of such lines was lately submitted to the Department and was approved by the Secretary of War under date of June 26, 1891.*

New Castle is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1891, is $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—		By act approved—	
May 20, 1826	$25,000.00	August 14, 1876	$12,000.0
March 2, 1829	18,895.99	June 18, 1878	10,000.0
July 2, 1836	25,000.00	March 3, 1879	5,500.0
March 3, 1837	10,000.00	June 14, 1880	3,000.0
July 7, 1838	11,573.00	March 3, 1881	20,000.0
August 30, 1852	15,000.00	July 5, 1884	2,000.0
July 15, 1870	2,500.00	August 5, 1886	5,000.0
June 10, 1872	27,000.00	By act of August 11, 1888	7,500.0
March 3, 1873	20,000.00	By act approved September 19, 1890	8,100.0
June 27, 1874	10,000.00		
March 3, 1875	$20,000.00		

Of the above the sum of $18,285.65 has been carried to the surplus fund of the Treasury.

Money statement.

July 1, 1890, balance unexpended	$7,346.4
Amount appropriated by act approved September 19, 1890	8,100.0
	15,446.4
June 30, 1891, amount expended during fiscal year	255.6
July 1, 1891, balance unexpended	15,190.7

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* See Appendix H 29.

H 3.

IMPROVEMENT OF APPOQUINNIMINK RIVER, DELAWARE.

This river is a tributary of Delaware Bay, flowing mainly in New Castle County, Del., and is navigable at low tide for vessels of light draft, from the mouth to Odessa, a distance of about 9 miles. The bar at the mouth is navigable only at high water. The tide rises on an average 6 feet at the mouth and 3.2 feet at Odessa.

A survey of the stream was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimates submitted for its improvement, which is printed in the Annual Report of the Chief of Engineers for 1890, pages 943–947.

The plan of improvement recommended is to dredge a channel 8 feet deep at mean low water, 100 feet wide within the section of the river between the mouth and Townsend's Wharf, a distance of 5 miles, and 80 feet wide in the remaining section as far as the bridge at Odessa. The estimated cost of improvement is $39,963.

The project was adopted in 1890, an appropriation of $5,000 being made by Congress on September 19 for beginning the work. It was subsequently proposed to expend the money in improving the river near Odessa, where the shoalest water was found. This was approved, and after due advertisement for proposals a contract was made with Frank C. Somers, of Camden, N. J., to do the necessary dredging at the price of 19 cents per cubic yard, measured in place.

Operations were begun on January 27, 1891, and completed on the 14th of the following month, two dredges having been engaged in the work. Twenty-four thousand nine hundred and eighty-five cubic yards of material, mostly soft mud, were removed, making a channel 80 feet wide on the bottom and 8 feet deep below the low water reference established at the Odessa bridge and extending from the lower end of Watkin's Wharf eastward to a point about 360 feet below Polk's Wharf, a total distance of 1,975 feet. The benefits derived from the dredging are increased harbor room at the wharves at Odessa and increased depth for vessels of greater draft.

It is proposed to expend any future appropriations in extending the channel in a down river direction, in accordance with the existing project.

This work is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1891, was $15,217.04.

AMOUNTS APPROPRIATED.

By act approved September 19, 1890	$5,000

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,963.72
July 1, 1891, balance unexpended	36.28
Amount (estimated) required for completion of existing project	34,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened January 12, 1891, by Gen. Wm. F. Smith, United States Agent, for dredging in Appoquinnimink River, Delaware.

No.	Name and address of bidder.	Time.		Price pe cubic ya measured in place.
		Commence.	Complete.	
				Cents.
1	Frank C. Somers, Camden, N. J	April 1, 1891	August 30, 1891	19

Contract with Frank C. Somers, dated January 22, 1891.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Weight.	Valu
Receipts:	*Tons.*	
Coal and phosphate material	3,950	$70,475.00
Tin plate and cans	154	33,000.00
General merchandise	3,200	320,000.00
Total	7,304	423,475.00
Shipments:		
Canned goods and fertilizers	1,605	78,500.
Fruit, grain, butter, cattle, and sheep	4,723	249,000.
General merchandise	5,500	220,000.
Total	11,828	547,500.
Total shipments and receipts	19,132	930,975.

Vessels trading in Appoquinnimink River.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	1	100	7	Semi and tri-weekly.
Schooners	2	160	6½	75 to 100 trips per ye

H 4.

IMPROVEMENT OF SMYRNA RIVER, DELAWARE.

This river was formerly Duck Creek, the name having been chang as above in 1889 by act of the legislature of the State of Delaware.

An appropriation of $5,000 was made by the river and harbor act September 19, 1890, for continuing improvement. Proposals for dred ing were opened on January 12, 1891. The lowest bid was receiv from the National Dredging Company, of Wilmington, Del., with who a contract was made on February 9, 1891, at the price of 17 cents p cubic yard, place measurement.

Work was begun on May 29, and at the end of the fiscal year is still in progress. The total amount of material removed up to June 30 is 13,139 cubic yards, which was deposited upon the banks of the river, and is mainly sand, fine gravel, and stiff clay.

The dredging was done in the upper part of the river, between Smyrna Landing and Rothwells Landing, which are about 2 miles apart. Five sharp points in the banks were cut off to give more turning room, and three shoals of an aggregate length of 2,240 feet, that had partly reformed since 1889, were redredged to the required depth of 6½ feet at low water. The width of the channel now being made is 40 feet. It is expected that the contract will be completed by August 1, 1891.

The improvement of this stream is based upon a survey made in 1887. The project is for a 7-foot low-water channel 60 feet wide from Smyrna Landing to the mouth, and 100 feet wide across the bar, the latter channel to be protected by a stone jetty, the total cost of the improvement being estimated at $90,698.40.

A project for the improvement of Duck Creek had been made in 1879, recommending a 6-foot low-water channel 40 feet wide within the creek and a channel, 100 feet wide and 8 feet deep at the entrance. It appears, however, that the improvement at the mouth was subsequently held to be of greater importance than that of the creek, on account, as then stated, of the evident desirability of harbors of refuge for the numerous small vessels engaged in fishing, oystering, and freighting that navigate the broad reaches of Delaware Bay, for which Duck Creek entrance furnished superior natural advantages. Between the years 1880 and 1882 appropriations aggregating $10,000 were expended by special direction of Congress in dredging the bar at the mouth. A channel nearly 100 feet wide and 8 feet deep at low water was made, but soon thereafter filled up again to such an unexpected extent that no further appropriation for dredging at that point was recommended by the officer in charge unless protective works were first provided for. Operations under the present project have been confined to dredging within the creek. The first appropriation of $10,000, made in 1888, was expended in making a channel 40 feet wide and 6 feet deep from Smyrna Landing to Brick Store Wharf, a distance of nearly 3 miles. Below this point there are still extensive but not very shoal bars in the river. That was the condition of the channel at the end of the fiscal year ending June 30, 1890, up to which time $10,000 had been expended. The result of the improvement was the extension of navigation nearly 2 miles farther up the river and a reduction in the hauling time of freight and in freight rates to and from Smyrna. The amount expended during the fiscal year ending June 30, 1891, exclusive of outstanding liabilities, is $2,536.35.

It is proposed to expend the amount asked for in continuing dredging within the river in pursuance of the project now in force.

Smyrna River is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1891, is $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—	
June 14, 1880	$5,000
March 3, 1881	3,000
By act passed August 2, 1882	2,000
By act of August 11, 1888	10,000
By act approved September 19, 1890	5,000

Money Statement.

Amount appropriated by act approved September 19, 1890		$5,00
June 30, 1891, amount expended during fiscal year		30
July 1, 1891, balance unexpended		4,69
July 1, 1891, outstanding liabilities	$2,233.63	
July 1, 1891, amount covered by uncompleted contracts	2,125.00	
		4,35
July 1, 1891, balance available		33
Amount (estimated) required for completion of existing project		22,36
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened January 12, 1891, by Gen. Wm. F. Sm United States Agent, for dredging in Smyrna River, Delaware.

No.	Name and address of bidder.	Time.		Pri per c yard meas in pla
		Commence.	Complete.	
				Cent
1	Atlas Dredging Company, Wilmington, Del	Apr. 1, 1891	June 30, 1891	
2	Frank C. Somers, Camden, N. J	Mar. 1, 1891	June 30, 1891	
3	National Dredging Company, Wilmington, Del	Apr. 1, 1891	Aug. 1, 1891	

Contract with National Dredging Company, dated February 9, 1891.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts—		
Bone, coal, iron, phosphate, rock, and ice	$6,800	$82,
Chemicals, canned goods, fertilizers, lumber, and flour	7,201	189,
Grain, truck, hay, potatoes, cattle, horses, and lime	23,731	296,
General merchandise	10,000	400,
Total	47,732	967,
Shipments—		
Cord-wood, railroad ties, and ship-timber	62,636	166,
Baskets, bricks, canned goods, crates, terra-cotta ware	98,336	1,835.
Fruit, truck, grain, hay, poultry, butter, and cattle	17,223	881,
General merchandise	5,000	200,
Total	183,195	3,082.
Total receipts and shipments	230,927	4,050,

Vessels trading in Smyrna River, Delaware.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	3	440	5 to 6	Daily in peach season and triweekl
Tug boats	5		6	Charter.
Schooners	3	250	5 to 7	Do.

H 5.

IMPROVEMENT OF ST. JONES RIVER, DELAWARE.

The improvement of this river was reported as completed at the close of the fiscal year ending June 30, 1890, and no further appropriation was recommended.

This work is in the collection district of Delaware. Wilmington is the nearest port of entry, at which the amount of revenue collected during the fiscal year ending June 30, 1891, was $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1881	$5,000
July 5, 1884	10,000
August 5, 1886	10,000
By act of August 11, 1888	15,000

Money statement.

July 1, 1890, balance unexpended	$490.52
June 30, 1891, amount expended during fiscal year	490.52

COMMERCIAL STATISTICS OF ST. JONES RIVER, DELAWARE, FOR YEAR ENDING DECEMBER 31, 1890.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products—pig-tin and lead, coal, ice	3,297	$23,987
Manufactured products—iron, fertilizers, lumber, tin plate, etc	5,569	239,115
Agricultural products—hay, cattle, horses, sheep, tropical fruit	569	80,938
General merchandise	2,200	210,000
Total	11,635	554,040
Shipments:		
Raw products—cord-wood and molding sand	557	1,950
Manufactured products—baskets, crates, canned goods, and lumber	4,170	241,025
Agricultural products—fruit, grain, cattle, berries, and potatoes	11,415	404,550
Total	16,142	647,525
Total receipts and shipments	27,777	1,201,565

Vessels trading in St. Jones River.

Class.	No.	Draft.	Total registered tonnage.	Trips.
		Feet.		
Steamers	1	5½	125	Tri-weekly.
Schooners	2	5½	135	Weekly.

The above statistics were furnished by the Lebanon Navigation Company, and Mr. M. S. Van Burkalow, of Rising Sun and Magnolia, Delaware.

H 6.

IMPROVEMENT OF MISPILLION CREEK, DELAWARE.

There were no operations during the fiscal year ending June 30, 189 for want of funds. A survey of the mouth of the creek was ordere by the act of September 19, 1890, "with a view of cutting a canal so to shorten the distance to the bay, and making an outlet in the ba which would furnish deeper water." The survey will be made durin the summer of 1891, and a report submitted in time for the action Congress.

The improvement of the creek began in 1879, the project being for 6-foot low-water channel 40 feet wide from Milford, the head of navig tion, to the mouth; and up to the close of the fiscal year ending Jun 30, 1889, the sum of $17,000 had been expended, with the result of clear channel of the required dimensions extending from Milford Flat Reach Shoal, a distance of 12 miles. This shoal remains to dredged in accordance with the original project, but it is recommende that further action be postponed until the report on the survey has bee submitted.

Mispillion Creek is in the collection district of Delaware. Wilmington is t nearest port of entry, at which the amount of revenue collected during the fiscal ye ending June 30, 1891, was $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1879	$3,0
June 14, 1880	4,0
March 3, 1881	3,5
By act passed August 2, 1882	3,0
By act of August 11, 1888	3,5

Money statement.

Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	$2,0

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value
Receipts:		
Bone, coal, phosphate rock, pig iron, and ice	12,750	$123,9
Chemicals, fertilizers, flour, lumber, and tin-plate	8,860	209,2
Hay	225	4,5
General merchandise	2,240	46,0
Total	24,075	383,6
Shipments:		
Cord wood, piles, railroad-ties, and ship timber	17,689	433,8
Baskets, crates, canned goods, and fertilizers	3,545	197,0
Grain and potatoes	2,033	65,0
General merchandise	200	6,0
Total	23,467	701,8
Total receipts and shipments	47,542	1,085,5

Vessels built and repaired at Milford, Del., during the year ending June 30, 1891.

Class.	No.	Registered total tonnage.	Draft of largest vessel when leaving ship yard.	Calculated maximum draft when loaded of largest vessel built.
			Feet.	*Feet.*
Built:				
Coal barges	2	700		
Schooners	2	1,700	8	16
Sloops	2	500	4	7
Repaired:				
Steamers	8	Unknown.		
Sail vessels	13	1,170		

Vessels trading to and from Milford, Del.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Schooners	29	1,430	4½ to 6½	4 to 30 trips per year.
Sloops	1	35	6½	2 trips per year.
Barges	3	560	7	3 trips per year.
Tugboats	2	50	5½	Daily.

H 7.

IMPROVEMENT OF BROADKILN RIVER, DELAWARE.

At the beginning of the fiscal year dredging, under contract with the American Dredging Company, at the rate of 7 cents per cubic yard of material removed, was still in progress. Operations had begun on May 28, 1890, and continued until October 30 following, when the available funds were exhausted. In consequence of the very low price for which the work was done the amount of material removed under the contract was considerably more than originally estimated, being 104,284 cubic yards. A continuous channel 6,300 feet long from Green Island to the mouth of the river, a section where no dredging had previously been done, was dredged for a width of 40 feet and to a depth of 6½ feet below mean low water, requiring the removal of 46,727 cubic yards of sand, gravel, and mud, the former predominating. The remaining material, 57,557 cubic yards, principally sand, was excavated at numerous sharp points in the upper river and at several shoals in the immediate vicinity of Milton, the head of navigation. The material was deposited on the bank nearest to the cut.

There is now a clear 6-foot low-water channel of not less than 40 feet in width inside the river from the mouth to the bridge at Milton, and the portion of the original project relating to the improvement of the channel within the river can be reported as completed.

The amount expended during the fiscal year ending June 30, 1891, is $8,876.81.

The original project was made in 1871, and is for a 6-foot low-water navigation from the mouth of the river to Milton, the head of navigation, and for a new entrance, protected by a jetty, at a total estimated cost of $80,447. The project was modified in 1881 as to the latter portion of it and the estimate reduced to $51,450.

Dredging has been done at various times since 1873 for a channel 40 feet wide and 6 feet deep at mean low water, and, as stated above, this channel is now completed.

The total amount expended up to the close of the fiscal year endi June 30, 1891, is $35,000.

This work is in the collection district of Delaware. Wilmington is the near port of entry, at which the amount of revenue collected during the fiscal year en ing June 30, 1891, was $15,217.04.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1873	$10,00
June 14, 1880	5,00
March 2, 1881	5,00
By act passed August 2, 1882	5,00
Ay act of August 11, 1888	10,00

Money statement.

July 1, 1890, balance unexpended	$8,876.8
June 30, 1891, amount expended during fiscal year	8,876.8
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	21,500.

COMMERCIAL STATISTICS OF BROADKILN RIVER, DELAWARE, FOR THE YEAR ENDIN DECEMBER 31, 1890.

	Tons.	Value.
Receipts.		
Raw products	1,870	$10,22
Manufactured products	600	6,40
Agricultural products	20	6,20
General merchandise	1,800	177,50
Total	4,290	194,32
Shipments.		
Raw products	29,880	68,00
Manufactured products	3,274	56,50
Agricultural products	556	17,05
Total	33,710	141,53
Total shipments and receipts	38,000	335,87

Tonnage belonging in river, 1,300 tons; transient, 1,000 tons. Draft of vessel trading in the river from 4 to 7 feet.

The above statistics were kindly furnished by Ex-Governor James Ponder, of Milton, and Mr. J. B. Dorman, of Drawbridge, Del.

H 8.

IMPROVEMENT OF INLAND WATER-WAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, AT OR NEAR LEWES, DELAWARE.

The object of this improvement is to connect by a navigable channe the many inland bays or lagoons which skirt the Atlantic coast in Accomac County, Virginia, Worcester County, Maryland, and Susse County Delaware; the termini to be on the south, Chincoteague Inlet on the north, Delaware Bay, at or near the Delaware Breakwater Harbor. The total length of the proposed water way is about 73 miles.

The project is based upon a survey made in 1884 in accordance with the requirements of the river and harbor act of July 5, 1884. The reports on the survey printed in the Report of the Chief of Engineers for 1885, pages 891-904, recommended an open cut between the points named 70 feet wide at the bottom and 6 feet deep below the mean low-water level established in the Delaware Breakwater Harbor, at an estimated cost of $350,000.

The project was adopted in 1886, an appropriation of $18,750 being made by Congress on August 5, with special direction that the money should be expended within that section of the proposed water way situated between Chincoteague Bay and Indian River Bay. The Chief of Engineers subsequently approved a recommendation (made by the officer in charge) to apply the appropriation to connecting the waters of Assawoman Bay and Indian River Bay by excavating a cut 8 feet wide at the bottom and 6 feet deep at mean low water of the ocean. In the place of the line originally surveyed between these bays, a new route was recommended which was further inland, shorter in distance, and which required less excavation. By avoiding the sandy soil and a close proximity to the ocean it was thought that the permanency of the cut would also be increased. The new line which runs straight from Jefferson Creek, a tributary of Assawoman Bay to White's Creek, a tributary of Indian River Bay, and is nearly 4 miles long from shore to shore, was approved in January, 1887.

The beginning of operations was delayed for over a year, awaiting the settlement of the question of right of way, which was to be given free of cost to the United States. On July 2, 1888, the Attorney-General of the United States approved the title to the lands needed and vested in the General Government by an act of the Delaware legislature passed at Dover April 4, 1887.

On August 11, 1888, Congress made an additional appropriation of $50,000 for continuing improvement on the inland water way, and directed that it be also used between Chincoteague Bay and Indian River Bay.

A new project was thereupon submitted, which was approved, to apply this appropriation, together with the balance of the appropriation of August 5, 1886, to increasing the proposed cut between Assawoman Bay and Indian River Bay, the width and depth to be governed by the price at which the work could be contracted for.

Proposals for connecting the bays above named by a cut about 4 miles long, 30 feet wide at the bottom, and 6 feet deep below the average water level of Assawoman Bay, were opened November 2, 1888. The bids received were considered too high and were rejected. The work was readvertised, the dimensions of the cut having been reduced to 20 feet in width at the bottom and to a 2-feet depth below the level of the bay. Proposals were again opened on December 18, 1888. The lowest bid appeared to be reasonable in price; after an investigation, it was found, however, that the guarantors to the proposal were irresponsible parties and that the bidders themselves were pecuniarily unable to carry on the work, and the bid was rejected. With the approval of the Chief of Engineers, a contract was entered into January 24, 1889, with the next lowest bidder, C. McLean, of New York City, at his bid of 21.9 cents per cubic yard, measured in place.

Work under this contract was begun February 14, 1889, and was to be completed on August 1, same year. Progress was, however, much delayed by a series of adverse circumstances, which mainly arose from injunctions being placed upon the contractor by certain parties dissatisfied with the awards made by the commission for land damages, from strikes of laborers and the refusal of adjoining property owners to sell necessary land for dumping ground except at exorbitant prices. Also from the prevailing unfavorable weather the first season, and from a lack, for a long time after operations had commenced, of an intelligent management of the work. In July, 1889, a supplementary agreement was made with the contractor to increase the depth in the cut to a depth of 4 feet below the level of Assawoman Bay, the width on the bottom to remain as previously fixed, 20 feet, and no payments for the additional 2 feet to be made until the 4-feet depth had been excavated from the corresponding depth in one bay to that in the other. The price for removing material within the additional depth in the cut was the same as agreed upon in the original contract, viz, 21.9 cents; the dredging in the bays, however, was to be paid for at the rate of 12 cents per cubic yard.

By direction of the Chief of Engineers the time for the completion of these contracts was extended at various intervals during the past 2 years, the last time to July 1, 1891.

The work was entirely finished on June 18, 1891. The amount of material excavated within the cut from shore to shore, a distance of 20,600 feet, was: Under the original contract, 190,577 cubic yards; under the supplementary contract, 55,219 cubic yards; or a total of 245,796. The number of cubic yards dredged in the bays was 3,019, making a grand total of 248,815 cubic yards of material removed under these contracts. The length of the cut dredged in Assawoman Bay to reach the 4-foot depth is 900 feet; the corresponding cut in White's Creek, Indian River Bay, is 1,300 feet. With the exception of four small shoals, which have recently formed at different points by reason of the bank having been undermined by ditches leading into the cut, the average depth throughout is slightly over the depth called for by the contract. These shoals will shortly be removed.

During the past fiscal year the three temporary wooden bridges, for which a contract was made March 24, 1890, were erected. These bridges were not provided with a draw. As there exists, however, a serious intention of using the canal, with its present width and depth, from Assawoman Bay to Indian River Bay for sail vessels large enough to ply between these waters and Philadelphia, and also by others to put in two or three small steamers to run from Ocean City, Md., to Rehoboth City, Del., a recommendation was recently made to the Department to put draws in the bridges, which was approved.

The water-level observations at the south and north ends of the canal made with self-registering tide gauges, with one of which an anemometer is connected, were continued until February, 1891, when the gauge at the upper end was removed to the head of Rehoboth Bay, since which time observations have been continued at the stations as rearranged. The results of the observations will be published in due time.

The river and harbor act of September 19, 1890, appropriated $50,000 for continuing this improvement, to be used from Chincoteague Bay to Delaware Bay, no part of which was to be expended until the right of way had been secured free of cost to the United States. It was contemplated after the passage of the bill to make arrangements for an early extension of the water way towards the Delaware Bay, but upon a close investigation it was found that the appropriation was not available even for locating the necessary line that had to be secured first. The money necessary for a survey was, however, subsequently secured from the survey fund, and a survey from Rehoboth Bay to Delaware Bay for the purpose of locating a final line for the canal was made during the past winter and a report submitted April 7, 1891, a copy of which is hereto appended.

This report recommends a line much farther inland than that proposed in 1885, which was not considered final. The reasons for the change are similar in nature to those that had previously tended to produce a change from the original location in the cut between Assawoman Bay and Indian River Bay, as related above, viz: the exposure of the original line to storm tides and drift sand and its close proximity to the ocean and the sandy beach. The final cost of the work was, in consequence of the change in location, much increased; the increase is, however, far outweighed by the greater permanency of the work and the decrease in the cost of maintaining it when completed.

AMOUNTS APPROPRIATED.

By act approved August 5, 1886	$18,750
By act approved August 11, 1888	50,000
By act approved September 19, 1890	50,000

Money statement.

July 1, 1890, balance unexpended	$45,730.74
Amount appropriated by act approved September 19, 1890	50,000.00
	95,730.74
June 30, 1891, amount expended during fiscal year	35,566.02
July 1, 1891, balance unexpended	60,164.72
July 1, 1891, outstanding liabilities	6,014.52
July 1, 1891, balance available	54,150,20
Amount (estimated) required for completion of existing project	231,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF W. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED, ON SURVEY OF CANAL BETWEEN REHOBOTH BAY AND DELAWARE BAY.

UNITED STATES ENGINEER OFFCE,
Wilmington, Del., April 7, 1891.

GENERAL: I have the honor to forward herewith a copy of a report of Mr. A. Stierle, assistant engineer, upon the survey of the canal between Rehoboth Bay and Delaware Bay, a part of the proposed water way from Chincoteague Bay to Delaware Bay.

For the reasons set forth in that full report I have to recommend the adoption of the Stockley Creek route or that numbered III on the tracing of the map* of the survey which is forwarded by mail to-day in a separate package.

The question of the termini and the number of public road bridges would more than outweigh any advantages possessed by either of the other lines.

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*Not printed.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., April 22, 1891.

Respectfully submitted to the Chief of Engineers.

In addition to the information derived from this report of Mr. Stierle, and those of Mr. Bird, printed in the Annual Report for 1885, Part I, pages 891–904, I have a personal knowledge of the country, gained when in charge of the surveys made some 10 or 12 years ago for a route for a ship canal to connect the Chesapeake and Delaware Bays.

The project for the inland water way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Del., proposes a channel to be made by dredging or otherwise, 70 feet wide at bottom and 6 feet deep below the mean low-water level in the harbor of the Delaware breakwater. The total estimated cost is given in the last annual report as $350,000, based upon the surveys of 1884–'85, of which $250,000 was stated as the probable cost of the connection between Rehoboth and Delaware Bays.

Mr. Stierle proposes as a result of his recent survey a change in the route between Rehoboth and Delaware Bays and his reasons therefor are good. His estimate for the new route now recommended by the local engineer is $575,000, an increase of over 100 per cent. for this section of the improvement over the former estimate. And it is stated that this last estimate does "not include the cost of protection works at the outlet of the canal, or the cost of the regulation of and inlets for drains, ditches, and lateral streams, tidal and fresh, that have to be led into the canal; or the expense of dredging turnouts and possibly ferry slips at private road-crossings; or of small land-locked harbors at each end of the route for the smaller class of sailing vessels."

As this work seems likely to cost so much more than the original estimate, and there are still so many elements of uncertainty as to the ultimate plan and its cost, and the total expenditure up to this time has been comparatively small, not much over $25,000, the question arises whether it may not be better to suspend further operations until a complete plan and estimate can be made and submitted to Congress for further consideration.

It is to-day learned that there is a desire upon the part of those interested in this work to have the necessary right of way granted at the present session of the legislature of Delaware, which may be terminated in April.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
April 22, 1891.

Respectfully returned to Col. Wm. P. Craighill, Corps of Engineers, for his recommendation as to the location of the proposed water way.

The river and harbor act approved September 19, 1890, appropriates $50,000 for the inland water way from Chincoteague Bay to Delaware Bay. The survey, the report on which is now presented, was made in order to locate the line of water way. The Division Engineer will call on the local engineer for such information as may be necessary to enable him to reach a definite conclusion as to the location.

H. M. ADAMS,
Major, Corps of Engineers, in Charge.

[Third indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., April 23, 1891.

Respectfully returned to the Chief of Engineers.

I visited Wilmington to-day in compliance with the orders of April 21. As I had not seen the instructions concerning the survey until to-day in the office of the local engineer, I could not previously know its special object.

I have gone over the subject with the local engineer and the assistant who made the survey. The information in hand is sufficient to enable the location to be settled between Delaware Bay and Rehoboth Bay. That recommended by the local engineer, the Stockley Creek route, or No. III, should be adopted. The estimate of the assistant engineer of its cost, $574,581, is satisfactory. To this sum, however, should be added 25 per cent. to cover the cost of the items referred to in my indorsement of April 22, as not included in the estimate. With this understanding the estimate for the connection between Delaware Bay and Rehoboth Bay will amount to $718,226. To this sum an addition should also be made for dredging *in* Rehoboth Bay, for which the estimate of page 904, Annual Report of 1885, Part I, is altogether inadequate. Nor can a proper estimate of the amount of this dredging be made, in my opinion, without further surveys *in* Rehoboth Bay.

Moreover, there should be a revision of the estimate of the cost of the remainder of the line to Chincoteague based on the experience gained on that portion where operations have already been in progress, in order that Congress may know how much this whole work will cost, which may be expected to be four or five times the sum stated in the last annual report as "required for the completion of the existing project." I believe the ultimate cost will be found to be nearer $1,000,000 than $231,500, the sum stated.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
April 27, 1891.

Respectfully submitted to the Secretary of War.

The river and harbor act of September 19, 1890, appropriates $50,000 for the inland water way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Del., no part of which is to be expended until the right of way is secured free of cost to the United States. The estimated cost of this water way as given by Maj. W. F. Smith in his report of January 14, 1885, is $350,000. The appropriation made by the act of September 19, 1890, was based upon this estimate.

Two former appropriations have been made, the act of August 5, 1886, appropriating $18,750, and the act of August 11, 1888, appropriating $50,000, both to be expended on that part of the route between Chincoteague Bay and Indian River Bay.

In order to locate the line of the canal from Delaware Bay to Rehoboth Bay, a survey has been made under the direction of Major Smith, and his report on this subject is presented herewith. The Division Engineer, Col. Wm. P. Craighill, Corps of Engineers, reports that the cost of that part of the water way between Delaware Bay and Rehoboth Bay will amount to $718,226. He also reports that the ultimate cost of completing the work will be found to be nearer $1,000,000 than $231,500, the estimate submitted by Major Smith in his annual report for 1890.

In view of the statements made by the Division Engineer, I recommend that the whole matter be reported to Congress and that the $50,000, appropriated by the act of September 19, 1890, be not expended until Congress has taken further action in the matter.

H. M. ADAMS,
Major, Corps of Engineers, in charge.

WAR DEPARTMENT,
April 28, 1891.

Approved as recommended by the officer in charge of the office of the Chief of Engineers.

L. A. GRANT,
Acting Secretary of War.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., March 31, 1891.

SIR: I have the honor to submit herewith a report upon the survey for a canal between Rehoboth Bay and Delaware Bay, a part of the proposed water way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Del., and approximate estimates of the cost of a canal of the approved dimensions along several lines held to be the most feasible. The accompanying map* and profiles* illustrate in a general way the main features of the country traversed by the different lines of reconnoissance.

1. GENERAL DESCRIPTION.

The country across which the canal is to be extended is in the eastern section of Sussex County, Delaware, and is commonly called Lewes and Rehoboth Hundred, the greater portion being known under the more local name of Rehoboth Neck. It is bounded on the north by the deep cove, formed by the western shore of Delaware Bay, in which the Delaware Breakwater is located; on the east by the Atlantic Ocean; and on the south by Rehoboth Bay. On the western boundary the Hundred is connected with the main body of the Delaware Peninsula by a narrow neck of elevated country not over one mile in width. The shortest distance between the bays, however, is in a due northerly or southerly direction about 6¾ miles. By far the greater portion of Lewes and Rehoboth Hundred forms an almost level plateau of a general altitude of 30 feet above the sea, whose geological formation is that of the later Tertiary periods. Nearer to and along the shores of the bays and the ocean the remaining land is much lower, consisting principally of marsh and of sand dunes of a very recent age. Considering the peculiar situation of this Hundred it may appropriately be called a peninsula.

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*Not printed.

The eastern bank of the plateau, which is quite marked and at some points very abrupt, runs parallel with the shore of the ocean at Rehoboth, then assumes a northwesterly direction just north of this place, turning away from the ocean and following more in the general direction of the western shore of Delaware Bay to a point north of the town of Lewes. Beyond this bank, and occupying nearly the whole northeastern section of the country under consideration, lies Cape Henlopen with its great sand dunes over 70 feet high.

Five small creeks drain the southern slope of Rehoboth Neck and flow into Rehoboth Bay. With the exception of Love Creek, the most westerly one, they are all mere surface drains, dry within the upper sections during several months in the year, indicating an almost total absence of springs. Near the mouths the creeks are broad and wide, and the shores are bordered with marsh and reeds, the water of the bay entering for more than a mile through a narrow open channel in which there is no perceptible current. Although Rehoboth Bay is connected at its southern extremity with the ocean through Indian River Inlet, there is scarcely any periodical rise and fall of the water-level at the upper end of the bay due to the tide, except that which is caused by high storm tides. The names of the creeks flowing into Rehoboth Bay on the north side are, in the order in which they follow from east to west, Miller Creek, Little Creek, Stockley Creek, Burton Creek, and Love Creek.

The water courses on the northeastern and northern slope of Lewes and Rehoboth Hundred are generally of greater length and depth, and as they drain a greater area and carry off much spring water, they are subject at times to swifter currents than those of the southern slope. The most southerly one is Holland Glade, whose course is northeast. The next one is Wolfe Glade, which runs about one mile northwest of, and parallel to Holland Glade. Towards the north flow Canary Creek and Black Oak Gut. All these streams, except the latter, are tributaries of Lewes Creek, which is 9 miles long, and which flows in a northwesterly direction close under the eastern slope of the plateau, and finally enters Delaware Bay, together with the Broadkiln River, about 5 miles north of the Delaware Breakwater Harbor. Black Oak Gut is a branch of Cool Spring Creek, a tributary of the Broadkiln.

Lewes Creek is unquestionably the remnant of a wide inland bay that formerly existed southwest of the present Cape Henlopen. The tide still ebbs and flows within the creek nearly up to its head, but the rise and fall is small compared with that in the bay outside. Storm-tides often inundate the whole region through which it flows, and also the low lands bordering on the glades mentioned above. Its character, as a former basin, is well indicated by its bottom, which consists of very soft and sticky mud extending to an almost unlimited depth.

Lewes and Rehoboth Hundred is crossed in its northern section from west to east by the Georgetown and Lewes branch of the Delaware, Maryland and Virginia Railroad, terminating at the town of Lewes, the oldest settlement in the State of Delaware. From Lewes a short spur branch of this road has of late years been extended to Rehoboth City, a somewhat well spread out and as yet thinly built-up summer resort on the Atlantic side, about 5 miles southeast of Lewes. There are many public roads in the Hundred, the most prominent being the road from Georgetown to Lewes, and the road from Lewes to Rehoboth, the former running nearly parallel with the railroad, and the latter, after extending from Lewes in a southerly direction for several miles and then turning gradually around towards the southeast, following the highest elevation in the center of Rehoboth Neck. From both of these main stems extend in various directions numerous smaller lateral roads, public as well as private, which are projected principally to maintain communication with the long necks of land situated between the different water courses.

The country described is a very fertile one, especially renowned as to the production of grain and fruit, and is thickly settled, containing many valuable and well-cultivated farms. Shipments by rail and water are large; there are, however, no industries other than those related to agriculture.

2. THE SURVEY.

In reconnoitering for a line where the proposed line was to cross the dividing ridge between Rehoboth and Delaware Bays, two principal points were kept in view: First, to use, as much as possible, existing water courses, and, second, to avoid whenever it could be done, the location of the line across cleared and valuable lands. The latter point was mainly considered in deference to the wishes of the farmers and leading men of the vicinity, who had taken great interest in the proposed improvement and entertained some doubt as to the sufficiency of the appropriation made by the legislature for land damages. The request was granted, however, without sacrificing any of the important requirements for the best location of the line as demanded from an engineering point of view. Of these requirements, three were considered as the leading features in the undertaking. The first one was that the outlet of the canal into deep water in Delaware Bay should be located as near as practicable under the shelter of the Delaware Breakwater, to make it comparatively safe and to avoid the expense of constructing elaborate works of protection. The second was the selection of a route as direct in alignment between the two bays as the configuration of the country would permit, without, at the same time, taking recourse to straight reaches of great length that would make it difficult to sail under head winds. The third requirement was a due economy in constructing the canal, especially the balancing of earthwork, all other things being equal.

Other minor features were considered in locating the line, as, for example, reducing the public road crossings to the least possible number, on account of the drawbridges required at such points by the act granting the right of way; avoiding buildings and other valuable improvements; dividing farms into inconveniently located and ill-shaped parcels of land; and the character of the bottom in the glades and creeks crossed by the line.

When the first general preliminary survey for this inland water way was made in 1885, the portion of the line then proposed between Rehoboth Bay and Delaware Bay commenced about 2 miles north of the town of Lewes and then followed in a southeasterly direction the lowlands along Lewes Creek, as far as the head of the stream, where it approached to within 2,000 feet of high-water mark on the beach of the ocean. In rounding then a very prominent and the most easterly point of the high plateau to the westward, the proposed line made a sharp detour in a southwesterly direction and continued for some distance nearly parallel with the beach and not over a mile west of it, passing the highland in the rear of Rehoboth city until it reached the head of Miller Creek, which it followed into Rehoboth Bay. The length of the line, as thus located, was 9.6 miles. The guiding point in locating it almost entirely upon the lowlands seems to have been the advantage it offered in economy of construction. Its close proximity to the ocean, however, would have constantly subjected it to storm tides and flying sand, and the continual expense to maintain the canal free from obstruction would more than counterbalance the gain in the original cost. The location is also objectionable from a military or strategic point of view. Besides that, in not passing through any of the cultivated sections of the country which is to be benefited by its construction, the canal would be of less availability as a highway for transportation.

The lines of the present survey were run across the country at a greater distance from the ocean. The importance of placing the outlet of the canal within the harbor formed by the Delaware Breakwater limited at the start the location of the northern terminus of the line somewhere on the shore of the harbor opposite the town of Lewes. It remained to find the shortest and at the same time the most economical line by which the divide of Lewes and Rehoboth Hundred could be crossed and then to bring the same into one of the numerous creeks flowing into Rehoboth Bay, preferably the one whose mouth is nearest to deep water in this bay.

In general three main lines of reconnoissance were run, from which subsequently numerous lateral lines were extended in exploring for shortening distances or in following apparent natural advantages in the elevations of the ground.

The first line left Rehoboth Bay by the way of Stockley Creek and followed the latter to its head, whence it crossed the highest elevation at the public road leading to Rehoboth. It then entered the head of Holland Glade and followed the course of this glade to Lewes Creek and down the latter to an assumed terminal point at the bridge at the foot of Market street in front of the town of Lewes.

The second line entered Burton Creek from Rehoboth Bay, followed the creek to the head, and after crossing the summit about one-third of a mile west of a small settlement called Midway run along Wolfe Glade, also a tributary of Lewes Creek, and down the latter to the same terminal point at Lewes.

The existence of many forks and branches at the heads of the creeks and glades mentioned, especially down the north and south slopes of the plateau, made it necessary in running these lines to trace out each branch separately and to connect their extreme points when any practical advantages could be gained by cross lines over the higher intervening ground. This was done in five different cases. The bottom lands of each creek and glade were in addition properly defined by traverse lines following each shore or the foot of the adjacent high land.

A reconnoissance for a third general line was made whilst the survey was in progress, at the urgent request of a large number of farmers and others living in the western section of Lewes and Rehoboth Hundred, whose presentation of their local claims deserved some recognition. This line commenced in Rehoboth Bay at the mouth of Love Creek, and followed the creek in a northwesterly direction as far as Burton Mill Pond. Here it circled round the east side of the pond, and followed for some distance a small branch in a northeasterly direction, crossing the divide and cleared land in a straight line from the head of this branch to the head of Black Oak Gut, a tributary of Cool Spring Branch, which flows into the Broadkiln River. Not far from the junction of Black Oak Gut and Cool Spring Branch, the line made a sharp detour towards the northeast, running along the southern edge of the broad marsh which skirts the Broadkiln until it reached Canary Creek, whose course it followed to its junction with Lewes Creek about 1¼ miles northwest of the town of Lewes. From the junction of these creeks two lines were optional to strike Delaware Bay. One was to continue the same course across Lewes Cape to the bay shore; the other could follow Lewes Creek in a southeasterly direction as far as the terminal point of the first and second main lines at Lewes. The first course would be a much shorter one in distance, but it would necessitate the location of the outlet in shoaler water and entirely away from the Breakwater Harbor. The second course, besides opening a possibility of constituting at some future day a part of the Broadkiln, of which mention will be made hereafter, has all the advantages, as far as the outlet is concerned, inherent in the lines that reach the Breakwater Harbor passing to the eastward of the town of Lewes.

The different lines of reconnoissance, as run with the instrument, add up in length as follows: On the first line, between the mouth of Stockley Creek and the junction of Holland Glade and Lewes Creek, 86,629 feet. On the second line, between the mouth of Burton Creek and the junction of Wolfe Glade and Lewes Creek, 59,494. Along Lewes Creek, from the junction of Holland Glade to the terminal point at Lewes, 18,544 feet. On the third line from the mouth of Love Creek to the terminal point at Lewes Bridge, via Love Creek, Black Oak Gut, Canary Creek, and Lewes Creek, 79,966 feet. The length of the spur and check lines between the main lines is 48,931 feet. The total length of all lines run is, therefore, 293,564 feet or 55.60 miles, of which about 30 miles were through dense woods and swamps. The profile of each line, with cross sections on either side of the more important lines, was taken by a leveling party which followed the transit party, and considering the time of the year, the short days and the state of the weather, the gentlemen in charge of the parties deserve credit for expeditious work. The survey was commenced on December 20, 1890, and was completed, with the exception of verifying a few bench marks, at the beginning of March, 1891.

3. DESCRIPTION OF THE MOST FEASIBLE ROUTES.

If the route suggested in 1885 is disregarded, on account of the objectionable features it embodied, which were above enumerated, the results of the survey exhibit three additional routes as available for the canal between the two bays, and amongst these one which appears to be the most feasible. The northern terminus of the canal having been directed by act of Congress to be located "at or near Lewes, Delaware," it will simplify a description of the routes by naming them after the creeks from which they debouch at the Rehoboth Bay terminus. They may accordingly properly be designated No. I, the Love Creek route; No. II, the Burton Creek route; and No. III, the Stockley Creek route.

Each line begins at high-water mark on the shore of Delaware Bay, which is well established by surveys of the Delaware Breakwater Harbor made under the direction of the Engineer Department, the maps of which were used in compiling the map of the present survey, and ends at the 6-foot contour in Rehoboth Bay, as indicated on the Coast Survey Chart dating back to about the year 1846. This 6-foot depth may since then have changed; not likely to any great extent, however; and it is safe to say that it corresponds in elevation, as recently disclosed by the line of levels, to about a 4-foot depth below the mean low water in the Breakwater Harbor. The plane of mean low water in the Breakwater Harbor is the adopted datum for the canal, and all elevations hereafter given refer to it. The approved dimensions of the canal are a depth of 6 feet below mean low water and a width of 70 feet at the base.

The Love Creek Route is 54,675 feet, or 10.33 miles long and begins at a point on the Delaware Bay shore opposite the junction of Canary Creek and Lewes Creek. Nearly the whole line is located on low marshy land or within existing water courses, and therefore presents favorable conditions for dredging. The portion requiring deepest cutting is at the crossing of the public road leading from Lewes to Georgetown and averages about 33 feet, with a maximum of 36 feet. The general direction for about 2 miles after leaving Delaware Bay is southwest across the Broadkiln marshes and partly along Canary Creek; then south for a distance of 4 miles, along Black Oak Gut and across the high ground into the north branch of Love Creek and Burton Mill Pond; and southeast for the remaining distance, following Love Creek into Rehoboth Bay.

Not less than seven public roads and the railroad cross this route, that would require as many drawbridges to maintain an uninterrupted traffic. The number of private roads affected is small, on account of the location of the line upon broad and in some cases deep water courses, which also made it possible to avoid almost entirely all cleared and cultivated land. With the exception of the damages for the comparatively valuable mill property at the head of Love Creek, which would practically be destroyed, the total cost to obtain the right of way along this route could not be very great.

The Burton Creek Route is 43,200 feet, or 8.18 miles, in length, of which 4 miles are over marsh lands and along water courses, and the remainder over elevations above the level of high-water mark. The line begins at the shore of the Breakwater Harbor opposite Lewes, and circling sharp around from north to east, after leaving the beach, enters Lewes Creek east of the town. Following the creek for about 1,800 feet it makes a detour in a southeasterly direction and continues closely along the foot of the mainland, which lies to the westward of it, partly cutting off a portion of Gill Neck, until it reaches Wolfe Glade, whence it crosses the north branch of the same, and entering the main branch follows the course of the latter to its head in a southwesterly direction for nearly 2 miles. From this point it passes in a straight line and south-southwesterly direction over the summit of Rehoboth Neck, which is 30 feet above low water. The length of this cut, which would have an average depth of 36 feet, is about 6,000 feet, the whole distance being across cleared and valuable farm land. Having crossed the plateau, the line enters the head of Burton Creek and follows the course of the latter throughout the remaining distance to Rehoboth Bay, changing its course to south-southeast about 1¼ miles north of the junction with the bay.

This route crosses three public and five private roads, and the Rehoboth Branch, and Lewes Branch, respectively, of the Delaware, Maryland and Virginia Railroad. At each crossing, except those of the private roads, a drawbridge will be necessary.

The Stockley Creek Route is 42,400 feet long, or about 8.03 miles, and coincides at its northern end with the Burton Creek route from the shore in the Delaware Breakwater Harbor to Wolfe Glade, a distance of 12,000 feet. From this point the line continues in a general southerly direction after crossing the glade and approaches the railroad. The transit across the latter is accomplished at an angle of 45 degrees, with a series of reverse curves connected at the point of intersection near the track with a short tangent, the low elevations of the adjacent land fortunately permitting this somewhat complex movement without much difficulty. About 1,500 feet beyond the railroad, the Northern or Presbyterian Church branch of Holland Glade is crossed by the line; it then passes across the point of land lying between the two main prongs of the glade, to get to the southern branch, and follows for over three-quarters of a mile, as near as practicable, the course of the latter, with a change of direction to the westward before reaching the head of the ravine, and cuts straight across the summit of Rehoboth Neck in a southwesterly direction, aiming directly for the head of Stockley Creek. The length of this cut is about 2,000 feet; it is the deepest on the route and the maximum elevation of the ground above the bottom of the projected canal being 39 feet, the average 35 feet. The line thence follows throughout the remainder of the route the course of the main branch of Stockley Creek, the general direction for a mile within the upper portion being southwest, and then southeast to Rehoboth Bay.

Except at a few narrow points of land near the northern and southern ends of the line, the only point where this route crosses valuable and cultivated land of any extent is at the Rehoboth Road and that is for a distance of only 2,000 feet. Here is also the only public road crossing of any importance, a thoroughfare very much in use. The second public road which the line intersects is east of Lewes, across the creek, a road which leads to the cape and the beach, having comparatively little traffic. The number of private road crossings is four. The two railroad crossings are almost identical with those of the Burton Creek Route; although the Rehoboth branch is in use only during the summer season and the Lewes branch, from the depot at Lewes to the Breakwater Harbor, is now rarely used, except for the hauling of sand, they both would need bridges to meet any possible extension of traffic.

4. ESTIMATES.

From the description above given, based upon the data obtained in these preliminary investigations, an approximate estimate of the cost of a canal of the projected dimensions along each line can be readily deduced. The estimates given below do not, however, include the cost of protection works at the outlet of the canal; nor the cost of the regulation of and inlets for drains, ditches, and lateral streams, tidal and fresh water, that have to be led into the canal; nor the expense for dredging turnouts and possibly ferryslips at private road crossings; also small land-locked harbors at each end of the route for the smaller class of sailing vessels. These details, which have to be studied later, will naturally augment the first cost; but, as they are applicable more or less to all the lines, an accurate estimate of them need not be given until one of the lines has been adopted and approved.

I. *Love Creek Route*, 10.33 miles long.

Excavation (2,172,085 cubic yards):	
Above high-water level, 761,448 cubic yards, at 20 cents	$152,289.60
Below high water level, 1,410,637 cubic yards, at 15 cents	211,595.55

Grubbing 30 acres, at $50	$1,500.00
Bridges:	
One iron drawbridge at railroad crossing	11,000.00
Seven iron drawbridges at public road crossings, at $6,000	42,000.00
	418,385.15
Add 10 per cent. for contingencies	41,838.85
Total	460,224.00

II. *Burton Creek Route*, 8.18 miles long.

Excavation (3,248,988 cubic yards):	
Above high-water level, 1,996,240 cubic yards, at 20 cents	$399,248.00
Below high-water level, 1,252,748 cubic yards, at 15 cents	187,912.20
Grubbing 41 acres, at $50	2,050.00
Bridges:	
Two iron drawbridges at railroad crossings, at $11,000	22,000.00
Three iron drawbridges at public road crossings, at $6,000	18,000.00
	629,210.20
Add 10 per cent. for contingencies	62,921.80
Total	692,132.00

III. *Stockley Creek Route*, 8.03 miles long.

Excavation (2,724,804 cubic yards):	
Above high-water level, 1,517,512 cubic yards, at 20 cents	$303,502.40
Below high-water level, 1,207,292 cubic yards, at 15 cents	181,093.80
Grubbing 76 acres, at $50	3,750.00
Bridges:	
Two iron drawbridges at railroad crossings, at $11,000	22,000.00
Two iron drawbridges at public road crossings, at $6,000	12,000.00
	522,346.20
Add 10 per cent. for contingencies	52,234.80
Total	574,581.00

Estimating, for comparison upon the same basis, the cost of a canal along the route proposed in 1885, the following exhibit is obtained:

Preliminary route of 1885, 10.64 miles long—

Excavation (1,861,266 cubic yards):	
Above high-water level, 271,045 cubic yards, at 20 cents	$54,209.00
Below high-water level, 1,590,221 cubic yards, at 15 cents	238,533.15
Grubbing 50 acres, at $50	2,500.00
Bridges:	
Two iron drawbridges at railroad crossings, at $11,000	22,000.00
Three iron drawbridges at public road crossings, at $6,000	18,000.00
	335,242.15
Add 10 per cent. for contingencies	33,234.85
Total	368,767.00

In the above estimates very liberal allowance has been made for the excavations in high ground. Provision is made for a road bed 20 feet wide on either side of the canal running at a general level of 12 feet above mean low water. These roads would, of course, be continued upon an embankment on the marsh and low lands with the material excavated from the cuts and would thus effectually protect the canal from the high storm-tides which occur occasionally and which are known to have never exceeded an elevation of 8¼ feet above mean low water at the Delaware Breakwater. By dispensing with one or the other of these roads in deep cuts, considerable reduction in the amount of material to be excavated can be made. It is thought best, however, to make the dimensions and estimates amply large in the first place, especially as to the width of cross-section, so that the strip of land which the State will give to the United States free of cost under the right of way clause may be sufficient to cover all possible contingencies that may arise in the future if the canal is deepened, a possibility that may well be kept in view.

5. CONCLUSION.

The Love Creek Route, though the cheapest in construction, is the longest in distance. It has many features unfavorable to a canal. The outlet is located upon a shoaling foreshore, which is undergoing constant changes under the combined effects of winds and sea. The bottom of Delaware Bay along this shore northwest of the Breakwater Harbor is one succession of shoals and bars, and no vessel bound up the bay from this point would run the risk of going up in a straight course, but would have to stand out due east first for a long distance, in order to reach the main channel. These shoals are slowly extending farther down the shore, and it would not be long before the outlet at that point would be embraced by them and would require constant expense to keep it open.

If, instead, the Breakwater Harbor, with its many lights and offering good anchorage ground, should be considered as a good location for the outlet of this route, the total length would be increased by two miles, or four miles longer than any of the other routes under consideration. This would make a difference in time of nearly one hour in favor of the other routes as applied to vessels in transit, and as time is a very important factor in this case it is a question whether, together with the additional time consumed in passing through the many bridges that obstruct this route, this fact alone is not sufficient to reject it.

The Burton Creek Route has, generally speaking, the straightest alignment, but the large amount of excavation across the summit of Rehoboth Neck makes it the most expensive in construction. In all respects it is very similar to the Stockley Creek Route and partly identical with the same, as both traverse the same country in close proximity to each other.

The route along Stockley Creek with the outlet opposite Lewes is the shortest in distance, and follows more than the others the general direction of the proposed inland water way, connecting, as it does, deep water in Rehoboth Bay with the Delaware Breakwater Harbor in the most direct practicable line. It is the route which deserves the most favorable consideration. The mouth of Stockley Creek is wide and deep and offers many facilities for the establishment of a sheltered harbor. The bridge at Rehoboth road crossing is the only point where the passage of vessels might be sometimes delayed on account of frequency of traffic. The bridge at Rehoboth Branch road could remain open nine months in the year. The town bridge at the foot of South street, Lewes, and the causeway across Lewes Creek, south of the railroad, leading towards Cape Henlopen, can both be dispensed with, and in the place of them the bridge at the railroad crossing can be made to serve for wagon traffic as well, thus maintaining uninterrupted communication with the beach and the cape.

The location of portions of the line in fast land towards the northern end has been determined upon with the expectation that the cuts thereat will yield sufficient material with which to construct across the marsh and the glades embankments high enough to exclude the storm-tides. If the latter should enter the canal at all, it is best that they should do so at the mouth and should oscillate up and down the trough of the canal instead of sweeping across transversely, which they would do if no embankment existed. This question of storm-tides brings with it another matter of inquiry which will have to be decided specifically before the canal is finished; it is an examination with reference to the advisability of building a tidal lock near Lewes to maintain a more constant water level in the canal and to exclude high tides and strong currents, ice, drift, sand, and sediment. The variation of the tide at the Breakwater Harbor is so great as to warrant these investigations.

The location of the outlet may appear to be somewhat too far to the westward with reference to the shelter offered by the breakwater. The point was selected partly to avoid a small settlement on the beach in front of Lewes, called Hugheyville, and mainly to evade the flying sand from the great sand dune at the cape. The sand is steadily encroaching on the marsh around it and has already filled parts of the former bed of Lewes Creek, and it was principally on account of the danger of filling up from that source that the outlet was shifted to the western portion of the harbor. Relatively it may not be amiss to state that the idea is prevalent and has been maintained for years (see Report of Col. W. Ludlow, on Delaware Breakwater Harbor, pages 457-462, Report of the Chief of Engineers for 1879) that this harbor will eventually be made a closed basin. The report referred to suggests the construction of a jetty within the upper portion of the harbor, running out from the shore to meet a prolongation of the ice-breaker. My own personal observations during a residence of 10 years in this locality have convinced me of the meager protection afforded by the present works to vessels at anchor during the prevalence of northerly and northwesterly gales. The harbor on the northwest side should be partly, if not wholly, closed in. The protection works, especially those on the north side, that are needed for the outlet of the canal may form the basis for such a project, as they could readily be extended from time to time if the effect upon the general regimen of the harbor should be found to be an advantageous one.

It may be also of interest to refer to the probability that the Broadkiln River, which has been improved of late years at great expense by the General Government, and whose inlet, situated about 4½ miles above Lewes, is still in an unimproved condition, having only 18 inches of water at the bar at low tide, may seek a new outlet in the future through this canal. Apart from the favorable opportunity which would accrue to the commerce of this river by having an unobstructed outlet at all times, the additional volume of water passing in and out of the mouth of the canal under the daily fluctuations of the tide would undoubtedly be a valuable acquisition for the maintenance of a proper depth of water in the entrance.

If the Stockley Creek route is adopted the strip of land necessary for the right of way should not be less than 300 feet wide. This will make a total of about 290 acres of land which the State of Delaware will give, free of cost to the United States, for this section of the proposed inland water way.

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

Gen. Wm. F. Smith,
United States Agent.

H 9.

IMPROVEMENT OF SUSQUEHANNA RIVER, ABOVE AND BELOW HAVRE DE GRACE, MARYLAND.

The river and harbor act of September 19, 1890, appropriated $4,000 for continuing improvement.

Pending the completion of a survey, provided for in the same act, of this portion of the river which is now being made for the purpose of modifying the existing project, this money is still unexpended.

The original project for the improvement of the river above and below Havre de Grace includes the making of a 15-foot low-water channel below the town and the removal of the shoal on the west side of the channel opposite Watson Island to a depth of 8 feet below mean low water. The channel below the town was dredged to a depth of 12 feet in 1885; its present condition shows that it has partially shoaled again.

The removal of the eastern bank of the shoal opposite Watson Island has been in progress since 1883. The object of this removal is to prevent, to a certain degree, the formation of ice gorges at or near Port Deposit, Md., about 2½ miles above Watson Island. At the close of the fiscal year ending June 30, 1890, about $32,000 had been expended on this shoal. The result has been a considerable increase in the original width of the channel, and, it is stated, the ice gorges have been noticeably lessened. The amount asked for for the fiscal year ending June 30, 1893, is the amount estimated for annual dredging.

Susquehanna River is in the collection district of Baltimore, which is also the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, is $3,716,922.22.

AMOUNTS APPROPRIATED.

By act approved—	
August 30, 1852	$10,000
June 23, 1866	26,400
July 11, 1870	12,000
June 14, 1880	28,000
March 3, 1881	15,000
By act passed August 2, 1882	25,000
By act approved—	
July 5, 1884	20,000
August 5, 1889	6,000
By act of August 11, 1888	10,000
By act approved September 19, 1890	4,000

Money statement.

July 1, 1890, balance unexpended	$372.25
Amount appropriated by act approved September 19, 1890	4,000.00
	4,372.25
June 30, 1891, amount expended during fiscal year	169.90
July 1, 1891, balance unexpended	4,202.35
Amount (estimated) required for annual dredging	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Statistics of Susquehanna River, above and below Havre de Grace, Md., for year ending December 31, 1890.

Class.	Tons.	Value.
Coal	65,810	$225,850
Lumber, shingles, and timber	34,327	274,635
Stone, sand, and ground flint	26,945	91,859
Fertilizers	1,150	27,700
Hay and grain	1,674	30,240
Spruce wood	7,875	35,000
General merchandise	5,785	217,800
Total	143,566	903,084

The above statistics were kindly furnished by Messrs. McClenahan & Bro., Spencer & McGonigal, and Eureka Fertilizer Company, of Port Deposit, Lapidum, and Perryville, Md., respectively.

H 10.

IMPROVEMENT OF NORTH EAST RIVER, MARYLAND.

North East River flows through Cecil County, Md., and empties into the head of Chesapeake Bay, not far from the mouth of the Susquehanna. The upper branches have the characteristics of mountain streams; the lower portion, 5 miles long, is a broad estuary and is navigable to the town of North East, at the junction of the two sections of the river. The tide rises about 2½ feet. About ¾ of a mile below North East is a bar with only 4 feet of water over it at low tide. This bar and the channel above were improved by dredging in 1873 and 1881 and $15,500 were expended.

A survey of the river at North East was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimate submitted for its improvement, which is printed in the Report of the Chief of Engineers for 1890, pages 951–954. The project is for a channel 6 feet deep at mean low water, 75 feet wide at the bar and 60 feet wide in the river up to Davis wharf. The estimated cost of the improvement is $5,140.

The project was adopted during the past fiscal year, an appropriation of $2,500 being made by Congress on September 19, 1890, to begin work.

A contract was made with Chester T. Caler, of Norfolk, Va., to do the required dredging at the price of 13¾ cents per cubic yard, scow measurement. The work was commenced on June 9, and lasted until the 30th of the month, during which time 16,000 cubic yards of material were removed from the channel across the bar. A continuous cut 40 feet wide, of an average depth of 6.7 feet at the time dredging was suspended, and 5,700 feet in length was made, beginning 3,200 feet below the bar and extending across the latter to deep water at the mouth of Stony Run.

The shipping interest at North East is at present very limited. It is believed, however, that with the opening of the bar recently accomplished vessels of a larger class than those now trading in the river will avail themselves of the advantages offered, and a regular steamboat line with Baltimore is contemplated.

It is proposed to expend the amount asked for, if appropriated, in completing the present project.

This work is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, is $3,766,922.22.

AMOUNTS APPROPRIATED.

By act approved—	
June 10, 1872	$10,000.00
June 14, 1880	5,500.00
September 19, 1890	2,500.00

Money statement.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	106.15
July 1, 1891, balance unexpended	2,393.85
July 1, 1891, outstanding liabilities	2,200.00
July 1, 1891, balance available	193.85
Amount (estimated) required for completion of existing project	2,640.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,640.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened March 20, 1891, by Gen. William F. Smith, United States agent, for dredging in North East River, Maryland.

No.	Name and address of bidder.	Price per cubic yard measured in scows.
		Cents.
1	Atlas Dredging Company, Wilmington, Del	20
2	Chester T. Caler, Norfolk, Va	13¾
3	Frank C. Somers, Camden, N. J	17
4	American Dredging Company, Philadelphia, Pa	16
5	Baltimore Dredging Company, Baltimore, Md	18¼

Contract with Chester T. Caler.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal and cord wood	1,963	$4,200
Fertilizers, lumber, and shingles	11,238	143,500
Total	13,201	147,700
Shipments:		
Cord wood and ship timber	1,563	3,000
Canned goods and sawed timber	1,072	44,800
Grain, hay, and potatoes	6,170	77,000
Total	8,805	124,800
Total receipts and shipments	22,006	272,500

H 11.

IMPROVEMENT OF ELK RIVER, MARYLAND.

Elk River is a large tributary of Chesapeake Bay. It joins the latter nearly at the head of the bay, in Cecil County, Md. The river is navigable as far as Elkton; beyond this town it has the characteristics of a mountain stream. The average rise and fall of the tide at Elkton is 2½ feet.

A survey of this river was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimates submitted for its improvement, which is printed in the Report of the Chief of Engineers for 1890, pages 965–968. The plan of improvement therein recommended is to dredge the channel from the upper wharves at the bridge to below Cedar Point, to a depth of 8 feet below mean low water, and to give it a width of 100 feet; the portion between the wharves to be widened to the full width; estimated cost of improvement is $24,000.

The project was adopted during the past fiscal year, an appropriation of $10,000 having been made by Congress on September 19, 1890, for beginning work. A contract dated April 8, 1891, has been made with Chester T. Caler, of Norfolk, Va., to do the necessary dredging at the rate of 12½ cents per cubic yard, scow measurement, but at the close of the fiscal year work had not yet begun. The available funds will be expended during the fiscal year ending June 30, 1892. With the amount asked for, if appropriated, dredging as proposed will be continued.

Elk River is in the collection district of Baltimore, which is the nearest port of entry.

The amount of revenue collected there during the fiscal year ending June 30, 1891, is $3,766,922.22.

AMOUNTS APPROPRIATED.

By acts approved—	
June 23, 1874	$5,000
March 3, 1875	5,000
June 14, 1880	10,000
March 3, 1881	5,000
By act passed August 2, 1882	6,500
By act approved September 19, 1890	10,000

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	57.82
July 1, 1891, balance unexpended	9,942.18
July 1, 1891, amount covered by uncompleted contracts	8,500.00
July 1, 1891, balance available	1,442.18
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened March 20, 1891, by William F. Smith, United States Agent, for dredging in Elk River, Maryland.

No.	Name and address of bidder.	Time.		Price per cubic yard, scow measurement.
		Commence.	Completo.	
				Cents.
1	Atlas Dredging Company, Wilmington, Del	June 1, 1891	Dec. 1, 1891	18
2	National Dredging Company, Wilmington, Del	July 1, 1891	Oct. 1, 1891	14
3	American Dredging Company, Philadelphia, Pa	Sept. 1, 1891	Nov. 10, 1891	19
4	Frank C. Somers, Camden, N. J	Sept. 1, 1891	Jan. 31, 1892	16$\frac{4}{10}$
5	Chester T. Caler Norfolk, Va	Aug. 20, 1891	Jan. 1, 1892	12½
6	Baltimore Dredging Company, Baltimore, Md	July 1, 1891	In 45 working days.	16⅞

Contract with Chester T. Caler.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal, cord wood, and phosphate rock	13,400	$88,300
Chemicals and fertilizers	1,800	24,000
Total	15,200	112,300
Shipments:		
Canned goods and fertilizers	2,634	57,200
Grain and hay	4,514	128,000
Total	7,148	185,200
Total receipts and shipments	22,348	297,500

Vessels trading in Elk River, Maryland.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	1	....	5	Semi-weekly.
Tugboats	4	190	6½ to 7	Weekly.
Schooners	150 to 175	1,300	5 9	During the season.

H 12.

IMPROVEMENT OF FAIRLEE CREEK, MARYLAND.

The river and harbor act of September 19, 1890, appropriated $5,000 for continuing improvement. A project for the application of this money was submitted September 25, 1890, and approved, for widening the channel dredged in 1889 outside the mouth of the creek to the approved width of 100 feet, and to dredge a channel inside about 44 feet wide from the mouth up the creek as far as the available funds would permit, all the dredging to be done to a depth of 7 feet below mean low water.

A contract was entered into April 8, 1891, with Chester T. Caler, of Norfolk, Va., to do the above work at the rate of 16 cents per cubic yard, scow measurement.

Dredging operations were begun on May 16, 1891, and were completed by June 24, 1891. The total amount of material removed under the contract was 28,125 cubic yards, of which number 7,451 cubic yards were removed from the outside channel leading to the entrance, and the remainder, 20,674 cubic yards, inside the creek. An examination made of the channel at the mouth before dredging began disclosed the fact that the cut made in 1889 had maintained its depth remarkably well. The banks on each side, which were quite steep on account of the deep excavation, were still well defined. The material, coarse gravel and stones, of which the bottom consists, is evidently too heavy for the littoral currents to move it into the cut and is too much below the water level to be disturbed by the agitation of the waves during storms.

The lighter material, like sand and clay, which moves up or down the shore according as the winds prevail, can not lodge in the cut on account of the strong currents therein, but a great deal of it is carried in during flood tide and already begins to form small shoals in the wide portion of the creek directly at the base of the entrance. Portions of these shoals were removed when the channel was extended upwards from the mouth.

Under this contract the channel outside the entrance was widened to 100 feet for an average length of 900 feet, and inside a channel about 4,738 feet long and 50 feet wide was made, with a depth in both cases of 7 feet below mean low water. The material, which at the mouth is coarse gravel, stones, and sand, and inside principally mud, was deposited in deep water in the bay, not nearer than 1 mile from the mouth of the creek.

The project adopted in 1887 embraces the dredging of a channel 100 feet wide and 7 feet deep at mean low water across the bar at the mouth, and inside the creek to a point about 2¾ miles above the entrance; also the dredging of a turning basin at the upper end of the proposed channel, if a wharf should be built there before the channel is finished. The total estimated cost of the improvement is $15,558.

At the close of the fiscal year ending June 30, 1890, a channel about 80 feet wide and 7 feet deep had been excavated from the 7-foot curve in the bay to the entrance, and the amount expended to that date was $5,000. The improvement was undoubtedly of some benefit to the one vessel which sails in and out of the creek, but there was no appreciable increase in commerce or navigation.

During the fiscal year ending June 30, 1891, the sum of $4,884.65 was expended, with the result of an increase in the channel dimensions as above given. The channel leading from the deep water in the bay to the entrance is now completed in accordance with the project. Inside the creek a channel has been made, beginning at the mouth, for a distance of 4,738 feet, which is 50 feet wide and 7 feet deep. The extent of the commerce is of the same small scale as last year, and it remains to be seen whether the additional improvements recently made will be a sufficient inducement to those interested to augment it. The amount asked for, if appropriated, will be expended in completing the channel inside the creek.

Fairlee Creek is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, was $3,766,922.22.

AMOUNTS APPROPRIATED.

By act of August 11, 1888	$5,000
By act approved September 19, 1890	5,000

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,884.65
July 1, 1891, balance unexpended	115.35
Amount (estimated) required for completion of existing project	5,558.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,558.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened March 20, 1891, by Gen. Wm. F. Smith, United States Agent, for dredging in Fairlee Creek, Maryland.

No.	Name and address of bidder.	Time.		Price per cubic yard, scow measurement.
		Commence.	Complete.	
				Cents.
1	American Dredging Company, Philadelphia, Pa	July 1, 1891	Aug. 1, 1891	18
2	Atlas Dredging Company, Wilmington, Del	Apr. 11, 1892	June 30, 1892	17
3	National Dredging Company, Wilmington, Del	Oct. 1, 1891	Dec. 1, 1891	20
4	Chester T. Caler, Norfolk, Va	June 10, 1891	Sept. 10, 1891	16
5	Baltimore Dredging Company, Baltimore, Md	June 1, 1891	Not given	$17\frac{3}{10}$
6	Frank C. Somers, Camden, N. J	Aug. 1, 1891	Oct. 31, 1891	$16\frac{4}{10}$

Contract with Chester T. Caler.
There are no regular lines of transportation on Fairlee Creek.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products—bone, coal, and phosphate rock	300	$4,600
Manufactured products—bricks, fertilizers, lumber, and flour	688	9,300
General merchandise	25	500
Total	1,013	14,400
Shipments:		
Raw products—logs, railroad ties, molding sand, and wood	756	3,180
Agricultural products—grain, hay, potatoes, and poultry	6,637	166,000
Total	7,393	169,180
Total receipts and shipments	8,406	183,580

LETTER OF MR. W. S. WALKER.

WHITE HOUSE, NEAR CHESTERTOWN, MD., *July 28, 1891.*

DEAR SIR: Although I am behind time I have concluded to forward you the statistics of the trade of Fairlee Creek, as furnished by Captain Middleton. By them you will find that my prediction of last year has almost been verified, as they have nearly four times the amount of traffic. I hope you will be able to amend your report before sending it in to the Department at Washington.

Yours truly,

W. S. WALKER.

Gen. WM. F. SMITH.

H 13.

IMPROVEMENT OF CHESTER RIVER, MARYLAND, FROM CRUMPTON TO JONES LANDING.

Chester River is one of the largest tributaries of the Chesapeake Bay on the eastern shore of Maryland, flowing principally along the boundary of Kent and Queen Anne counties, and is about 40 miles long and entirely a tidal stream. The river is navigable for vessels drawing 6 feet of water to Crumpton, a small village 33 miles above the mouth; above that place the channel is interrupted by many shoals with less than 3 feet of water over them at times. The average rise and fall of the tide at Crumpton is 2.13 feet.

A survey of the section of the river from Crumpton to Jones Landing was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimate submitted for its improvement, which is printed in the Report of the Chief of Engineers for 1890, pages 954-959. The plan of improvement therein proposed is to dredge a channel 6 feet deep at mean low water and 60 feet wide from Crumpton to a point 1 mile below Millington, supposed to be Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750.

The project was adopted during the past fiscal year, an appropriation of $5,000 being made by Congress on September 19, 1890, for beginning improvement. A contract, dated June 16, 1891, has been made with the National Dredging Company, of Wilmington, Del., for the required dredging, the price being 10 cents per cubic yard, measured in place. The work has not yet been commenced, but it is to be completed before May 1, 1892.

The amount asked for will be applied, if appropriated, to an extension of the proposed channel by dredging.

This work is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, is $3,766,922.22.

AMOUNT APPROPRIATED.

By act approved September 19, 1890	$5,000.00

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	7.65
July 1, 1891, balance unexpended	4,992.35
July 1, 1891, amount covered by uncompleted contracts	4,500.00
July 1, 1891, balance available	492.35

Amount (estimated) required for completion of existing project.......	$7,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,750.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened May 29, 1891, by Gen. Wm. F. Smith, United States Agent, for dredging in Chester River, Maryland.

No.	Name and address of bidder.	Time.		Price per cubic yard, measured in place.
		Commence.	Complete.	
				Cents.
1	Atlas Dredging Company, Wilmington, Del	Jan. 1, 1892	June 30, 1892	20
2	Frank C. Somers, Camden, N. J	Oct. 1, 1891	Dec. 20, 1891	20
3	National Dredging Company, Wilmington, Del..........	Mar. 1, 1892	May 1, 1892	10

Contract with National Dredging Company, dated June 16, 1891.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Fertilizers	400	$10,000
General merchandise	664	27,560
Total	1,064	37,560
Shipments:		
Canned goods	535	35,276
Grain and garden truck	1,518	37,353
General merchandise	300	12,000
Total	2,349	84,629
Total receipts and shipments	3,413	122,189

H 14.

IMPROVEMENT OF CHOPTANK RIVER, MARYLAND.

At the beginning of the fiscal year work under an agreement with the American Dredging Company for dredging at 15 cents per cubic yard was still in progress. Operations had been begun June 25, 1890, and continued until August 22 following, when the available funds became exhausted. The total amount of material removed was 43,827 cubic yards, principally sand, coarse gravel, and stones, which was all deposited on one side of the cuts made. Dredging was done at five principal points in the river for a channel 40 feet wide on the bottom and 8 feet deep at low water. At Greensboro a cut was dredged from Case Wharf to a point 2,400 feet above. The depth of cutting here was very great on account of the shallow water, no dredging ever having been done here before. Another cut was dredged in a down-river direction from a point just below the same wharf for a length of 978 feet, over a shoal which had previously been deepened to 5 and 6 feet. A cut 720 feet long was made through the shoal at Cohee Landing, and a channel of the required dimensions was excavated for a length of 1,764 feet through the shoal at Brick Mill Landing, the largest shoal in this section of the river. The last work done was the removal of a projecting point in the west bank of the river, just above Denton, where the turn in the channel was so sharp that vessels often ran aground.

By authority of the Chief of Engineers a channel 65 feet wide, 450 feet long, and 9 feet deep was excavated in October through a shoal about 3 miles below Denton, which had been reported an obstruction to navigation. The work was done under agreement with the American Dredging Company for the sum of $260, and 3,250 cubic yards of material were removed.

The object of this improvement, which has been carried on since 1881, is to make an 8-foot low-water navigation from deep water in the lower river to the bridge at Greensboro, with a channel 75 feet wide, and the estimated cost of the improvement is $79,000.

At the close of the fiscal year ending June 30, 1890, $30,137.62 had been expended, and about 3 miles of the total distance, having a depth of from 5 to 7 feet at low tide, remained to be improved. This distance was reduced by the operations carried on during the past fiscal year to about 1¾ miles, at an expense of $7,376.01.

The improvement has been of great benefit to the country around the town of Greensboro and below.

For the past 4 years a steam barge has been making regular trips between this town and Baltimore. Two large schooners and a number of small sailing vessels also trade regularly in the river. It is reported that another steamboat line for the transportation of freight and passengers to and from Baltimore will be established.

The river and harbor act of September 19, 1890, appropriated $7,500 for continuing improvement. The money will be applied toward the widening and deepening of those portions of the channel that were heretofore improved to a less depth and width than has been proposed. Proposals for dredging were opened on May 29, 1891, and a contract has been entered into with Chester T. Caler, of Norfolk, Va., at the price of 14½ cents per cubic yard, place measurement. The work had not yet been begun at the close of the fiscal year.

It is proposed to expend the amount asked for, if appropriated, in dredging the channel to the full proposed width and depth in accordance with the original project.

Choptank River is in the collection district of Baltimore, which is also the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, was $3,766,922.22.

AMOUNTS APPROPRIATED.

By act approved—	
June 14, 1880	$5,000
March 3, 1881	5,000
By act passed August 2, 1882	5,000
By act approved—	
July 5, 1884	5,000
August 5, 1886	10,000
By act of August 11, 1888	7,500
By act approved September 19, 1890	7,500

Money statement.

July 1, 1890, balance unexpended	$7,362.38
Amount appropriated by act approved September 19, 1890	7,500.00
	14,862.38
June 30, 1891, amount expended during fiscal year	7,376.01
July 1, 1891, balance unexpended	7,486.37
July 1, 1891, amount covered by uncompleted contracts	6,500.00
July 1, 1891, balance available	986.37
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened May 29, 1891, by Gen. Wm. F. Smith, United States Agent, for dredging in Choptank River, Maryland.

No.	Name and address of bidder.	Time—		Price per cubic yard, place measurement.
		Commence.	Complete.	
1	Atlas Dredging Company, Wilmington, Del	Jan. 1, 1892	June 30, 1892	$0.24
2	C. T. Caler, Norfolk, Va	July 10, 1892	Dec. 20, 1892	.14½
3	Frank C. Somers, Camden, N. J	Dec. 15, 1891	Mar. 31, 1892	.20

Contract with C. T. Caler.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	2,040	$5,269
Manufactured products	3,447	221,857
Agricultural products	227	12,048
General merchandise	765	30,600
Total	6,479	269,774
Shipments:		
Raw products	3,052	24,780
Manufactured products	2,238	121,885
Agricultural products	2,935	83,653
General merchandise	100	4,000
Total	8,325	234,318
Total receipts and shipments	14,804	504,092

H 15.

IMPROVEMENT OF HARBOR AT CAMBRIDGE, MARYLAND.

The river and harbor act of September 19, 1890, appropriated $5,000 for continuing the improvement of this harbor. A project for the application of this money was submitted on September 25 following, which proposed the widening of the channel at the bar and inside the harbor below the drawbridge in accordance with the original project. This was approved. Upon a petition to the Department from certain citizens of Cambridge, through the Hon. Chas. H. Gibson, requesting that the money be expended above the drawbridge, so as to at once increase the anchorage area of the harbor, the Chief of Engineers directed that a new project for the application of the appropriation in dredging the harbor above the drawbridge be submitted. Having made a personal examination of the harbor, a new project was submitted January 2, 1891, recommending the removal of certain small shoals between the steamboat wharf and the county bridge, and dredging a cut 250 feet wide and 8 feet deep at low water towards the head of the upper or inner harbor. This recommendation was made under the supposition that action shall be taken with reference to the county bridge, under sections 4 and 5 of the river and harbor act of September 19, 1890, without which the money, in my opinion, could not be profitably expended under this project or under the project approved for a channel 150 feet wide and 8 feet deep at low water.

The present draw in the bridge referred to is only 29 feet wide. It is desirable that the width should be made 60 feet, and the county commissioners, the custodians of the bridge, were so notified. The commissioners have indicated by letter their willingness to make the required change in the dimensions of the draw, but as yet no information has been received of what practical steps have been taken by them towards the carrying out of the contemplated alteration. In conformity with the directions of the Chief of Engineers that the project submitted January 2 will receive further consideration when the work of widening the draw to 60 feet has been completed, no preparations have yet been made for the expenditure of the available funds.

The approved project is based upon a survey made in 1887. It provides for a channel 150 feet wide and 12 feet deep at mean low water from that depth in the Choptank River to the railroad wharf; for dredging a certain irregular area within the harbor to a depth of 10 feet below mean low water; and for a channel 150 feet wide and 8 feet deep at the same stage of tide from the drawbridge above the railroad wharf to the upper limits of the harbor.

The harbor has been under improvement by the General Government since 1871. Previous to that year the citizens of Cambridge had expended $7,500 in its improvement. A project was submitted in 1871 by Col. William P. Craighill, Corps of Engineers, and approved, which provided for a channel 150 feet wide across the bar at the entrance and for dredging the same and the interior of the harbor to a depth of 8 feet at mean low tide. The project was completed in 1879. The channel at the entrance, however, needing enlargement soon thereafter, an appropriation of $2,500, made in the same year, was expended in 1884 in increasing the width as far as the funds would permit. At the end of that year the total amount expended under the first project was $32,500. The amount expended under the existing project is $4,918.72, making a total expenditure of $37,418.72 to date for the improvement of the harbor.

The general result of the improvement is such that the larger class of schooners engaged in carrying ice and ship timber, which heretofore were compelled to anchor outside in the Choptank River and to discharge and to receive their cargoes by means of lighters, can now sail into the harbor as far as the railroad wharf. The freight on those staple articles has in consequence been reduced, and a demand for a larger class of vessels is on the increase.

It is proposed to expend the amount asked for, if appropriated, in continuing the improvement in accordance with the approved project.

Cambridge Harbor is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1891, was $3,766,922.22.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1871	$10,000
June 10, 1872	10,000
March 3, 1873	5,000
June 18, 1878	5,000
March 3, 1879	2,500
By act of August 11, 1888	5,000
By act approved September 19, 1890	5,000

Money statement.

July 1, 1890, balance unexpended	$100.00
Amount appropriated by act approved September 19, 1890	5,000.00
	5,100.00
June 30, 1891, amount expended during fiscal year	18.72
July 1, 1891, balance unexpended	5,081.28
Amount (estimated) required for completion of existing project	7,736.60
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,736.60
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	120	$840
Manufactured products	2,615	96,440
Agricultural products	1,472	71,925
General merchandise	30,600	924,000
Total	34,807	1,093,205
Shipments:		
Raw products	....	....
Manufactured products	3,816	208,055
Agricultural products	9,503	815,543
General merchandise	1,400	50,000
Total	14,719	1,072,598
Total receipts and shipments	49,526	2,165,803

H 16.

IMPROVEMENT OF WICOMICO RIVER, MARYLAND.

Wicomico River is a tributary of Chesapeake Bay, entering through Tangier Sound from the east. It is a tidal river, and navigable to the town of Salisbury, Wicomico County, Md., about 23 miles above the mouth. The tide rises on an average 3 feet.

A survey of this river was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report, with estimates, submitted for its improvement, which is printed in the Report of the

Chief of Engineers for 1890, pages 947–951. The plan of improvement therein recommended is to dredge a 9-foot low-water channel from the natural 9-foot depth in the river below to the drawbridge at Salisbury, the width of the channel to be 150 feet, at an estimated cost of $23,200.

The project was adopted during the past fiscal year, an appropriation of $10,000 being made by Congress on September 19, 1890, for beginning improvement. A contract dated June 15, 1891, has been made with Frank C. Somers, of Camden, N. J., to do the necessary dredging at the rate of 12 cents per cubic yard, scow measurement. The contractor had not commenced operations at the close of the fiscal year, but it is expected that the contract will be completed by October 1, 1891.

The available funds will be expended during the fiscal year ending June 30, 1892, and further appropriations, if made, will be applied towards a completion of the channel as projected.

Wicomico River is in the collection district of the eastern district of Maryland. Crisfield is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1891, was $———.

AMOUNTS APPROPRIATED.

By act approved—	
June 10, 1872	$5,000
March 3, 1873	5,000
June 23, 1874	5,000
March 3, 1875	5,000
August 14, 1876	5,000
June 18, 1878	5,000
March 3, 1879	3,000
June 14, 1880	5,000
March 3, 1881	2,000
July 5, 1884	10,000
September 19, 1890	10,000

Money statement.

July 1, 1890, balance unexpended	$957.06
Amount appropriated by act approved September 19, 1890	10,000.00
	10,957.06
June 30, 1891, amount expended during fiscal year	42.43
July 1, 1891, balance unexpended	10,914.63
July 1, 1891, amount covered by uncompleted contracts	9,000.00
July 1, 1891, balance available	1,914.63
Amount (estimated) required for completion of existing project	13,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	13,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened May 29, 1891, by Gen. William F. Smith, United States Agent, for dredging in Wicomico River, Maryland.

No.	Name and address of bidder.	Time.		Price per cubic yard, scow measurement.
		Commence.	Complete.	
1	Atlas Dredging Company, Wilmington, Del	Jan. 1, 1892	June 30, 1892	$0.20
2	C. T. Caler, Norfolk, Va	Jan. 10, 1892	June 30, 1892	.14½
3	Frank C. Somers, Camden, N. J	Aug. 20, 1891	Dec. 31, 1891	.12
4	National Dredging Company, Wilmington, Del	Mar. 1, 1892	July 1, 1892	.25

Contract with Frank C. Somers.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	3,090	$17,850
Manufactured products	19,981	284,880
Agricultural products	786	49,855
General merchandise	4,000	160,000
Total	27,857	512,585
Shipments:		
Raw products	1,561	$4,000
Manufactured products	5,635	105,555
Agricultural products	209	13,605
General merchandise	1,000	40,000
Total	8,405	163,160
Total receipts and shipments	36,262	657,745

Vessels trading in Wicomico River, Maryland, at Salisbury.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	1	571	6	Tri-weekly.
Schooners	6	Unknown..	6 to 8	Irregular.

A large number of smaller craft is also engaged in a general carrying trade to and from Salisbury.

H 17.

IMPROVEMENT OF MANOKIN RIVER, MARYLAND.

Manokin River is a tidal stream and flows through Somerset County, Maryland, into Tangier Sound, Chesapeake Bay. The length of the stream from Princess Anne, the head of navigation, to the junction with the sound is about 18 miles. The lower portion of the river is, for a distance of 10 miles, a wide estuary, quite shoal at certain points; the upper portion is narrow, and has a fairly good channel depth. Within the region where these two sections join there is a bar called the "mud flats" forming an obstruction nearly 3 miles in length, extending across the entire river, and which heretofore made navigation impossible except for vessels of very light draft. The mean rise and fall of the tide is 2.6 feet at the mud flats, and 2.1 feet at Princess Anne.

A survey of this river was made in accordance with the requirements of the river and harbor act of August 11, 1888, and the report, with estimates for its improvement, is printed in the annual report of the Chief of Engineers for 1890, pages 959–964. The plan of improvement therein recommended is for a channel, 100 feet wide and 6 feet deep at low water, from Locust Point to Sharp Point, embracing the section called the "mud flats," the estimated cost being $30,000.

The project was adopted in 1890, an appropriation of $7,500 being made by Congress for beginning work. After due advertisement, a contract was entered into with Frank C. Somers, of Camden, N. J., to do the necessary dredging at the rate of 15¾ cents per cubic yard, measured in place. It was calculated that the available funds would make a very narrow cut of a depth somewhat less than was proposed across the full extent of the "mud flats." This was an important point to gain, as the river could at once be made available for larger vessels.

Operations under the contract were begun March 3, 1891, and completed on May 2, following, the total amount of material removed being 36,058 cubic yards, making a channel 30 feet wide, 5 feet deep at low water and about 13,515 feet long, between Locust Point and Sharp Point. The material was mostly stiff clayey mud. As an experiment, all the material was deposited at an average distance of 60 feet from the edge of the cut on the south side, to concentrate, in a manner, the currents into the cut. This side is closer to the shore, which is more elevated than the north bank and more covered with woods; it forms in consequence, a better shelter for the protection of the bank thrown up, and the material washed off the bank when the water is agitated under the prevailing northerly winds will float away from the cut and towards the south shore. During the short time elapsed since dredging was suspended the bank has settled but slightly and is everywhere visible except near the lower point at the cut where the water was originally deeper. The material is so sticky that it does not easily give way under the combined effects of wind and waves, and as the river carries but little sediment the training which the currents receive from the bank will be for a long time to come a valuable auxiliary in maintaining a proper depth in the cut.

By the authority of the Chief of Engineers an agreement was made with Mr. Somers to remove by dredging six projecting points at various localities in the upper river, at his contract price of 15¾ cents per cubic yard. These points very much impeded navigation, but since they have been partly cut off much relief has been given. Five thousand nine hundred and fifty-eight cubic yards of material were removed under the agreement.

The opening of the shoal mud flats, which hitherto have been the only obstacles in the way of making this river as useful to the people of Somerset County as its otherwise fair depth would warrant, will be, it is stated, a turning point in the commerce and navigation of the Manokin. The small steamer plying between Princess Anne and Deals Island and connecting with the steamers of the Maryland Steamboat Company to and from Baltimore, now makes regular trips regardless of the tide, whereas before not a single through trip could be safely depended upon. A larger boat in the place of the present one is already spoken of. Oyster pungies and fishing boats from the bay, that never ventured further than the mud flats, now sail directly up to Princess Anne, and with the present fair prospect for good crops of all kinds it is safe to say that the new outlet by water will be of great benefit to the surrounding agricultural country.

It is proposed to expend the amount asked for, if appropriated, in widening the dredged channel across the "mud flats." The sum of $7,360.12 was expended during the fiscal year ending June 30, 1891.

Manokin River is in the collection district of the eastern district of Maryland. Crisfield is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1891, is $———

AMOUNT APPROPRIATED.

By act approved September 19, 1890.. $7,500

Money statement.

Amount appropriated by act approved September 19, 1890	$7,500.00
June 30, 1891, amount expended during fiscal year	7,360.12
July 1, 1891, balance unexpended	139.88
Amount (estimated) required for completion of existing project	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received and opened January 12, 1891, by Gen. William F. Smith, United States Agent, for dredging in the Manokin River, Maryland.

No.	Name and address of bidder.	Time.		Price per cubic yard, place measurement.
		Commence.	Complete.	
1	C. T. Caler, Norfolk, Va.	Nov. 1, 1891	June 30, 1892	$0.17
2	Baltimore Dredging Company, Baltimore, Md	Apr. 15, 1891	Working to a finish.	.16¼
3	Frank C. Somers, Camden, N. J	Apr. —, 1891	Aug. 31, 1891	.15¾
4	Atlas Dredging Company, Wilmington, Del	Mar. 1, 1891	June 30, 1891	.18

Contract with Frank C. Somers, dated January 23, 1891.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts—		
Bone, cord wood, phosphate rock, and ice	5,100	$45,000
Bricks, canned goods, fertilizers, flour, and lumber	4,143	158,900
Grain, hay, horses, potatoes, and butter	1,217	31,800
General merchandise	100,000	2,000,000
Total	110,460	2,235,700
Shipments—		
Coal, railroad ties, and ship timber	6,543	33,500
Bricks, canned goods, flour, and lumber	1,225	32,000
Fruit, grain, hay, poultry, cattle, and sheep	5,830	181,480
General merchandise	20,000	800,000
Total	33,598	1,046,980
Total receipts and imports	144,058	3,282,680

Besides one steamer of 4 feet draft making daily trips, there are about 300 schooners, sloops, pungies, etc., engaged in the coastwise trade sailing from this river.

H 18.

IMPROVEMENT OF ONANCOCK HARBOR, VIRGINIA.

Onancock Harbor, or, more properly speaking, Onancock River, is a small tidal tributary of Chesapeake Bay, in Accomack County, eastern shore of Virginia, and is about 5 miles long. The channel within the river is fair, the main obstruction being at the bar at the mouth where the channel is very narrow and the least depth of water 5½ feet. Two distinct obstructions exist here—the bar proper and a "middle ground" adjacent to it. The average rise of the tide is 2 feet.

This harbor has been under improvement before, $8,000 having been expended in dredging a channel 100 feet wide and 8 feet deep at mean low water across the bar, and one of the same width and 7 feet deep near and above Wise Point, and near the wharves at Onancock.

A survey of the harbor was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimates submitted for its improvement, which is printed in the Report of the Chief of Engineers for 1890, pages 968–971. The plan of improvement recommended therein is for a channel 300 feet wide at the outer bar, and 200 feet wide at the inner bar or middle ground, both to be dredged to a depth of 8 feet at mean low water.

The estimated cost of the improvement is $12,511. The project was adopted in 1890, an appropriation of $6,000 being made by Congress on September 19. A contract was entered into with Frank C. Somers, of Camden, N. J., on June 15, 1891, to do the dredging at 18.9 cents per cubic yard, scow measurement. At the close of the fiscal year work had not been commenced; the contract, however, requires that it must be finished before the winter of 1892.

Future appropriations, if made, will be expended in accordance with the approved project.

Onancock is in the collection district of Cherrystone, Va. Cape Charles City is the nearest port of entry and the amount of revenue collected there during the fiscal year ending June 30, 1891, is $———

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1879	$3,000
June 4, 1880	5,000
September 19, 1890	6,000

Money statement.

Amount appropriated by act approved September 19, 1890	$6,000.00
June 30, 1891, amount expended during fiscal year	29.75
July 1, 1891, balance unexpended	5,970.25
July 1, 1891, amount covered by uncompleted contracts	5,250.00
July 1, 1891, balance available	720.25
Amount (estimated) required for completion of existing project	6,511.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,511.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received and opened May 29, 1891, by Gen. William F. Smith, United States Agent, for dredging in Onancock Harbor, Virginia.

No.	Name and address of bidder.	Price per cubic yard, scow measurement.
1	Chester T. Caler, Norfolk, Va	$0.19½
2	Frank C. Somers, Camden, N. J	18$\frac{9}{10}$

Contract with Frank C. Somers.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal and ice	1,200	$5,400
Bricks, fertilizers, flour, lumber, and shingles	2,375	64,250
Grain	987	42,900
General merchandise	4,000	160,000
Total	8,562	272,550
Shipments:		
Fertilizers and lumber	1,081	16,500
Fruit, truck potatoes, eggs, and poultry	8,761	249,700
General merchandise	100	4,000
Total	9,942	270,200
Total receipts and shipments	18,504	542,750

Vessels trading in Onancock Harbor, Virginia.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	3	1,838	6 to 7	Semi-weekly.
Schooners	10	416	5½ to 8	Weekly.

H 19.

IMPROVEMENT OF HARBOR AT CAPE CHARLES CITY AND APPROACHES BY CHENTON (CHERRYSTONE) INLET, VIRGINIA.

The harbor of Cape Charles City is an open, artificial, rectangular tidal basin excavated in the shore of the Chesapeake Bay, about 12 miles north of the promontory of the peninsula formed by the State of Delaware and the eastern shores of Maryland and Virginia. It is in Northampton County, Va., and forms the land terminus of the New York, Philadelphia and Norfolk Railroad, from which all transfers of freight and passengers by water are made to and from Norfolk, Va., having been constructed for that purpose. The area of the harbor is about 10 acres. The tide rises 2.6 feet.

A survey of this harbor and its approaches was made in accordance with the requirements of the river and harbor act of August 11, 1888, and a report with estimates submitted for its improvement, which is printed in the Report of the Chief of Engineers for 1890, pages 971–979. The plan of improvement therein recommended is for dredging the harbor and the entrance thereto to a depth of 14 feet below mean low tide; the dredging to a depth of 16 feet at mean low tide of the present channel in Cherrystone Inlet and across Cherrystone Bar for a width of 100 and 200 feet, respectively; and for constructing works of stone at the entrance to the harbor; the estimated cost of the project being $142,340.

The portion of the project relating to dredging was adopted in 1890, an appropriation of $25,000 being made by Congress for that purpose. By authority of the Chief of Engineers proposals for dredging were invited by circular letter, and a contract was entered into with the American Dredging Company of Philadelphia, the lowest bidder, to perform the work at the rate of 18 cents per cubic yard, scow measurement.

Operations commenced December 16, 1890, two dredging machines being employed, and were completed March 26, 1891, the work having been much interfered with by unfavorable weather. The total number of cubic yards of material removed was 107,079, distributed as follows: From the harbor proper, 24,781; from the entrance, 69,915; and from the channel in Cherrystone Inlet, 12,383 cubic yards. The material was principally sand with some mud; about one-half was deposited in deep water in the bay outside of Cherrystone Bar, and the remainder in a deep cove about 2 miles south of Cape Charles City.

About one-half of the area of the harbor was dredged to a depth of 14 feet below mean low water. A single cut 50 feet wide was made within the entrance, gradually widening out in a southerly direction in approaching Cherrystone Inlet, reaching a width of 480 feet at the junction with the latter. Upon a solicitation of the railroad company, the removal of a shoal in Cherrystone Inlet, about one mile south of the entrance, was recommended to be included in this year's work, and the change having been approved, part of the shoal was removed, making a cut 600 feet long and 80 feet wide. Dredging in both the entrance and in Cherrystone Inlet was made to 16 feet below mean low water.

The dredging was of immediate and great benefit to the heavy, deep draft vessels employed in the transshipments of freight and passengers. Especially was this the case after the entrance had been widened, where navigation in stormy days and thick weather was formerly extremely difficult.

It is proposed to continue dredging operations as projected if the amount asked for is appropriated.

Cape Charles Harbor is in the collection district of Cherrystone, Va. Cape Charles City is the nearest port of entry and the amount of revenue collected there during the fiscal year ending June 30, 1891, is $——.

AMOUNTS APPROPRIATED.

By act approved September 19, 1890	$25,000

Money statement.

Amount appropriated by act approved September 19, 1890	$25,000.00
June 30, 1891, amount expended during fiscal year	21,676.89
July 1, 1891, balance unexpended	3,323.11
Amount (estimated) required for completion of existing project	20,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	700	$11,550
Manufactured products	205,956	1,740,300
Agricultural products	68,012	5,050,488
General merchandise	12,681	507,240
Total	287,349	7,309,578
Shipments:		
Raw products	1,170	37,862
Manufactured products	65,101	7,738,205
Agricultural products	4,880	898,693
General merchandise	31,707	1,268,280
Total	102,858	9,943,040
Total receipts and shipments	390,207	17,252,618

Vessels using Cape Charles Harbor during year ending December 31, 1890.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	3	1,200	6½ to 9	Daily.
Tugboats	6	800	11 to 11½	Do.
Schooners	75	Unknown.	3 to 8	Two or three times a year.
Sloops	50	Do.	....	Do.

H 20.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On July 24, 1890, the sunken schooner *Maria Green* was reported a dangerous obstruction to navigation in Jackson Creek, Chester River, Maryland.

After notice to owners and advertisement for proposals, bids for the removal of the wreck were opened on September 29, 1890, and contract was made October 10, 1890, with the lowest bidder, W. H. French. The work was completed on the 25th of the same month at a total cost of $514.57, the wreck having been placed unbroken on the mud flats beyond the possible limits of any navigable channel.

Notice was received October 17, 1890, that the sunken schooner *Mary A. Rhoades* was a dangerous obstruction to navigation in Smyrna River, Delaware, near Eagle Nest Landing. Proposals were opened for her removal, after publication of notice to owners and advertisement, on January 5, 1891, and a contract for the work was made January 22, 1891, with the lowest bidder, Mr. B. G. Bailey. The contract was completed on March 15, 1891. The wreck was blown up and the débris hauled up on the marsh above high water at a cost of $500.

The collector of customs at Baltimore on December 26, 1890, reported an obstruction in Chesapeake Bay off Poplar Island. This was found, on examination, to be the wreck of the schooner *Mary Ellen*, lying directly in the main channel of the bay about 4½ miles east of Holland Point, in 10 fathoms of water, and was dangerous to navigation by reason of her foremast projecting above the water about 8 feet.

With a view to clearing away the rigging and spars, proposals were called for by advertisement and the bids were opened February 27, 1891. In the mean time information was received that the obstruction had disappeared, and upon a reëxamination it was found that the wreck has been carried away, and as it was deemed unnecessary to take any further steps in the matter the bids were all rejected.

Abstract of proposals opened September 29, 1890, for removal of wreck of schooner Maria Green, in Jackson Creek, Chester River, Maryland.

No.	Name and address of bidder.	Price.	Amount allotted.
1	W. H. French, Norfolk, Va	$440	$550
2	Louis E. Broom, Baltimore, Md	470	....

Contract with W. H. French.

Abstract of proposals opened January 5, 1891, for removal of wreck Mary A. Rhoades, in Smyrna River, Delaware.

No.	Name and address of bidder.	Price.		Amount allotted.
		Above high water.	Above low water.	
1	Frank C. Somers, Camden, N. J.	$485	....	$500
2	Chas. W. Johnston, Lewes, Del	1,400	$1,490	....
3	B. G. Bailey, Philadelphia, Pa	....	447	....

Contract with B. G. Bailey.

Abstract of proposals opened February 27, 1891, for removal of wreck of schooner Mary Ellen, in Chesapeake Bay.

No.	Name and address of bidder.	Price.	Amount allotted.
1	Jos. D. Truxton, Lewes, Del	$420	$300
2	Elijah D. Register, Lewes, Del	330	....
3	Chas. W. Johnston, Lewes, Del	345	....
4	W. H. French, Norfolk, Va	340	....
5	Louis E. Broom, Baltimore, Md	400	....

Bids all rejected.

H 21.

PRELIMINARY EXAMINATION OF LINCHESTER RIVER, MARYLAND.

[Printed in House Ex. Doc. No. 161, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 6, 1891.

SIR: I have the honor to submit the accompanying copy of report dated December 29, 1890, by W. F. Smith, United States agent, major of Engineers, U. S. Army, retired, giving results of a preliminary examination of Linchester River, Maryland, made in compliance with requirements of the river and harbor act approved September 19, 1890.

With no commerce at present and very little in prospective, this stream is considered by Major Smith and by the Division Engineer, Col. William P. Craighill, Corps of Engineers, to be not worthy of improvement.

I concur in the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF W. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 29, 1890.

GENERAL: In compliance with instructions in Department letter of September 20, 1890, and the requirements of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Linchester River, Maryland, made under my direction by Mr. A. Stierle, assistant engineer, a copy of whose report is herewith inclosed.

Considering the existing condition of Linchester River, Maryland, with no commerce at present and very little in prospective, the stream is, in my opinion, not worthy of improvement and no survey is recommended.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 3, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 29, 1890, by the local engineer, I am of the opinion that Linchester River, Maryland, is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 27, 1890.

SIR: In compliance with your instructions, I have the honor to submit the following report upon the preliminary examination of Linchester River, Maryland:

Linchester River is a small prong of the Choptank River, about 3½ miles long as far as the tide flows. At that distance from the mouth a mill dam crosses it; above that the head consists of several short branches or drains. The stream forms a part of the southern boundary of Caroline County, Md., and was formerly called Hunting Creek, the name having been changed by act of the Maryland legislature.

Linchester River is comparatively straight in the upper and very crooked in the lower section, and is bordered nearly throughout its whole course by marshy flats. Judging from the great distance between the high banks on either side its bed must have been once a very wide one, but is now reduced to a narrow stream, winding from one side of the valley to the other. The channel is irregular, deep holes and shallow bars alternating. A bar, extending one-half mile out into the Choptank River and having only from 2½ to 3 feet of water over it at low tide, obstructs the mouth of the river. From the mouth to a point 2 miles above, called Back Landing, the average depth is said to be about 5 feet, and from there to the head at the mill dam about 3 feet. The tide rises about 2 feet.

The river is bordered on both sides by land well adapted to the cultivation of berries, fruit, and melons, indicating a light soil. At and near the head of the stream are two small villages, Preston and Linchester Post-Office, which claim to be interested in the improvements asked for. The population of both combined is about 300, and both places are stations on the Baltimore and Eastern Shore Railroad. There is at present no lack of transportation facilities convenient for the country around the river. Directly at its junction with the Choptank River are located three steamboat landings, belonging to as many different companies. Besides the Baltimore and Eastern Shore Railroad which crosses at its head, there is also the Cambridge and Seaford Railroad, a branch of the Delaware division, which runs about 5 miles south of and parallel with the river. With all these convenient shipping points so near at hand, it is not surprising that navigation on this small river is very limited. Only one small sailing vessel trades regularly in and out of the stream.

I was informed by a gentleman who owns a farm adjoining the upper section of the river that it is the desire of the community to have a 6-foot channel dredged from Back Landing to the head, a distance of over a mile, to give small vessels an opportunity to go further up, so as to shorten the hauling distance of all freights to and from the river. This, it is said, would be of special advantage during the melon season. The shoal water at the bar appears to be at present no hindrance to navigation in the minds of the projectors of this movement; yet it is not clear why a vessel that can get over the bar, where the depth is only 3 feet, should not be able to reach the head of the stream where the same depth prevails. It is almost certain that the making of a 6-foot low-water navigation inside the river will necessitate improvements at the bar, and it is very questionable whether the comparatively large sum of money which these improvements would cost, probably from $10,000 to $15,000, would aid sufficiently to create a commerce that would warrant that outlay. Some local trade might be developed by improving the river; it would appear, however, from the above, that the proportions of the same can not be large in the face of so many convenient shipping points located in the immediate neighborhood.

Mr. R. D. Bradley, at Linchester Post-Office, has kindly furnished the following commercial statistics relative to the country around Linchester River, and it is assumed that the shipments and receipts were made by rail and water from and at the points previously referred to in this report:

"Number of farms, 155; tons of fertilizers used, 1,000; bushels of lime, 30,000; wheat shipped, 50,000 bushels; corn, 75,000 bushels; fruit, 75,000 baskets; tomatoes grown, 1,000 acres; melons (a new growing industry here), 15 vessel loads; eggs shipped, 15,000 dozen; poultry, 75,000 pounds; lambs and calves, 1,000 head; coal consumed, 500 tons; building lumber received, 200,000 feet, besides shingles, brick, lime, and other building supplies. There are four canning houses, one creamery, and twenty stores; volume of business, $75,000. The above estimate is considered low." * * *

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

General Wm. F. Smith,
United States Agent.

H 22.

PRELIMINARY EXAMINATION OF NORTHWEST FORK OF NANTICOKE RIVER, MARYLAND.

[Printed in House Ex. Doc. No. 163, Fifty-first Congress, second session.]

Office of the Chief of Engineers,
United States Army,
Washington, D. C., January 7, 1891.

Sir: I have the honor to submit the accompanying copy of report, dated December 29, 1890, by W. F. Smith, United States Agent, Major of Engineers, U. S. Army, retired, giving results of a preliminary examination of "Nanticoke River, Maryland, the northwest fork of the same," made in compliance with requirements of the river and harbor act approved September 19, 1890.

It is the opinion of Major Smith and the Division Engineer, Col. William P. Craighill, Corps of Engineers, that the locality is not worthy of improvement; in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF W. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 29, 1890.

GENERAL: In compliance with instructions in Department letter of September 20, 1890, and the requirements of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Nanticoke River, Maryland, the Northwest fork of the same, made under my direction by Mr. A. Stierle, assistant engineer, a copy of whose report is herewith inclosed.

In view of the facts given in the report of the assistant, I am of the opinion that the nature of the trade which might be developed by the improvement is too limited to justify the expenditure by the General Government, and that the stream is not worthy of improvement by the United States.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 3, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 29, 1890, by the local engineer, I am of the opinion that Nanticoke River, Maryland, the northwest fork of the same, is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 27, 1890.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of Nanticoke River, Maryland, the northwest fork of the same.

The headwaters of the northwest fork of the Nanticoke, also called March Hope Creek, are in Kent County, Del. The course is a general southerly one, through Caroline and Dorchester counties, Md., and is about 34 miles in length, the junction with the main stem of the Nanticoke taking place opposite Riverton, a small village in Wicomico County.

It is a stream which drains a very large area of country and which is subject to heavy freshets. These freshets make extensive deposits, forming shoals and bars in the upper tidal portion of the river. About 14 miles above the mouth of the fork is the town of Federalsburg, where a mill dam crosses the river valley and where the influences of the tide are still slightly felt, although the prevailing current is more or less in a down-river direction. The average rise and fall of the tide is said to be 2 feet at Federalsburg and 2½ feet at the mouth. The stream is navigable for vessels drawing 7 feet of water to a point 7½ miles below Federalsburg called Hickory Landing. Here is the first shoal, though small in width, with only 5 feet of water over it at low water. Above this point are about eight bars of considerable size, over which the depth of water varies from 1½ to 4 feet and between which are sections of the stream with depths of 6 and 7 feet.

Immediately at and near Federalsburg the river is shoal and the bottom apparently coarse sand and gravel. Several miles below the town the bottom consists mainly of fine sand. One of the bars consists almost exclusively of sawdust swept in several years ago during the breaking of a dam of an adjoining mill. The river flows through a very wide valley, but is very sinuous and has many sharp turns. Its width at Federalsburg is about 80 feet; at Hickory Landing, 7 or 8 miles below, the least distance between the shores is about 600 feet. Federalsburg is the only town of any prominence on this fork. It has 600 inhabitants, two flour mills, 1 kindling-wood factory, and one sash and door factory. The country close to the Nanticoke is well settled and cultivated, the land being especially adapted to the raising of grain.

The people of the town just named, and vicinity, desire an 8-foot low-water channel extended to that place. For shipping facilities they depend at present upon the Seaford and Cambridge Railroad, which passes through the town, and upon water transportation afforded by their own river from Brown's Wharf, 5 miles below, and from several landings on the Choptank River, the nearest of which is about 8 miles west of the Nanticoke. All the freight received or shipped by water is carried upon lighters between Brown's Wharf and Federalsburg, involving much risk and delay. The freight on grain to Baltimore by rail is said to be 7½ cents per bushel, whereas by water it would perhaps be but 4 or 5 cents. It is in the transportation of grain and other bulky articles where the improving of the upper section of this fork of the Nanticoke would be of benefit.

Light and perishable freight would preferably, in any event, be shipped from the present existing points along the railroad and on the Choptank River. The latter stream runs almost parallel with this fork throughout its whole course, on an average about 9 miles to the westward of it, and by a sudden turn to the west flows into Chesapeake Bay. The Nanticoke, however, continues in a southwesterly direction for a long distance and finally opens into Chesapeake Bay 36 miles below the mouth of the Choptank River. It is obvious that a vessel leaving the Choptank, flowing only a few miles west of Federalsburg, at the same time with one leaving this town, if such could be the case, and going down the Nanticoke, should, if bound for Baltimore, for example, arrive much sooner than the other, since the course by the Nanticoke would be at least 70 miles longer.

About the same distance as the Choptank, 9 miles southeast from Federalsburg, are two streams, the main branch of the Nanticoke and Broad Creek, both being navigable for vessels drawing 7 feet, as far as the towns of Seaford and Laurel, in Delaware, which are both stations on the Delaware Railroad.

The improvement of the upper section of the northwest fork of the Nanticoke would undoubtedly be of great value and importance to the town of Federalsburg, situated at the head of the stream. It is a question, however, whether the expense for the improvements, which, according to information received, would have to be extended over a section of the stream nearly 8 miles long, and which undoubtedly would be considerable, would be justified as long as an increase in commerce within a comparatively limited area only may be anticipated.

The following commercial statistics, relating to shipments and receipts in 1889 by rail and water from the country tributary to the northwest fork of the Nanticoke River in the vicinity of Federalsburg, were furnished by Mr. E. E. Goslin, of that town.

Shipped:

Wood	cords..	20,000
Grain	bushels..	175,000
Railroad ties		20,000
Eggs	dozen..	500,000
Poultry	pounds..	400,000
Fruit	baskets..	500,000
Watermelons		100,000
Charcoal	bushels..	200,000
Canned goods	cases..	14,000
Live stock	worth..	$32,000

Received:

Fertilizers	tons	1,500
Coal	do	500
Oyster shells	bushels	20,000
Lime	do	40,000
General merchandise	worth	$125,000

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 23.

PRELIMINARY EXAMINATION OF TANGIER HARBOR, VIRGINIA.

[Printed in House Ex. Doc. No. 172, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 14, 1891.

SIR: I have the honor to submit the accompanying copy of report dated January 9, 1891, from Wm. F. Smith, United States agent, major of Engineers, U. S. Army, retired, giving results of preliminary examination of Tangier Harbor, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

In view of the facts given in the report of his assistant, Major Smith does not consider Tangier Harbor worthy of improvement by the General Government. This opinion meets with the approval of the Division Engineer, Col. Wm. P. Craighill, Corps of Engineers, and is concurred in by this office.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF W. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., January 9, 1891.

GENERAL: In compliance with instructions in Department letter of September 20, 1890, and the requirements of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Tangier Harbor, Virginia, made under my direction by Mr. A. Stierle, assistant engineer, a copy of whose report is herewith inclosed.

In view of the facts given in the report of the assistant, I do not consider Tangier Harbor, Virginia, worthy of improvement by the General Government.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 10, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of the local engineers and from my own knowledge of the locality, it is my opinion, having in view both the present and prospective demands of commerce, that Tangier Harbor, Virginia, is not worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington Del., January 7, 1891.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of Tangier Harbor, Virginia.

Tangier Harbor is a natural cove or indentation in the shore, on the east side and near the southern extremity of Tangier Island.

Tangier Island is the most southerly one of a chain of islands in the Chesapeake Bay, which extend in an almost due southerlydirection from Bishop's Head Point, in Dorchester County, eastern shore of Maryland, and which form the dividing line between Tangier Sound and the main channel of the bay.

The island is in the State of Virginia and is a low alluvial formation, with a general elevation not more than 2 feet above high water, through which innumerable small channels and drains run in every direction. The shore line on the west side is fairly straight and is about 4½ miles in length; on the east side it is very much serrated, giving the island a triangular shape, with the greatest width about 2 miles at the apex, the west shore forming the long side of the triangle. Its area may be about 3 square miles. From the southern point extends a long and very narrow hook in a southeasterly direction, which finally returns upon itself and thus forms a natural harbor, sheltered from the north around by west to south. This harbor is also known as Cod Harbor. It is an excellent harbor of refuge for the oyster and fishing boats plying upon Tangier Sound, with good holding ground for anchors, and an average depth of water of 10 feet.

The island is inhabited by about 800 people, who live principally by fishing and oystering. A very small area of the land is fit for cultivation, the main portion being marsh. There is also one schoolhouse and a church, besides six stores. About in the center of Tangier Harbor stand, upon an isolated wooden pier, a few frame buildings, originally erected for a so-called fish factory, where large catches of menhaden are boiled down during the summer season for the purpose of extracting the oil. This factory was built about 14 years ago. A small store was subsequently added to these buildings, and, for the last 4 years, the Eastern Shore Steamboat Company have made this pier a landing place, stopping twice per week on their route between Baltimore and Snow Hill, Md. Communication between the island and this pier is maintained in small boats, like it is everywhere else over the island. A horse was landed here some time ago and was looked upon as a great curiosity.

I have been informed that the people desire a channel dredged about 7 feet deep and 100 feet wide from the center of the harbor towards the shore to give them better facilities for landing. The present landing at the isolated pier is nearly one-half of a mile from the shore and is difficult of access in rough weather. The proposed cut would obviate this difficulty and would locate the landing nearer the center of the island. There can be no doubt of the great convenience that would accrue to the inhabitants by such an arrangement, but there is at present no commerce except that absolutely necessary to supply the necessaries of life, and no increase is possible under any circumstances. The urgency of the improvement by the General Government is not apparent, and it is very doubtful, if the surrounding conditions are considered, whether the improvements, if made as suggested, would be of lasting benefit to the community concerned. The cut certainly could not be a permanent one.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 24.

PRELIMINARY EXAMINATION OF BROAD CREEK RIVER, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 13, 1890.

GENERAL: In compliance with the instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Broad Creek River, Delaware, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts and for the reasons set forth in the report of the assistant engineer, a copy of which is herewith inclosed, I deem Broad Creek River, Delaware, worthy of improvement, and as the desired work embraces only that portion of the stream which has already been under improvement by the Government and the condition of which is known, no further survey is necessary.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.
(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer, I agree with him that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 12, 1890.

SIR: In compliance with your instructions I have the honor to submit herewith a report upon the preliminary examination of Broad Creek River, Delaware.

"Broad Creek River" is evidently a pleonastic attempt to distinguish this stream from others with similar names in this and adjoining States. This river is Broad Creek, a tributary of the east fork of the Nanticoke River, and rises in Cypress Swamp, in the lower part of Sussex County, Del. Its navigable length is about 7 miles, and its course is due west.

The creek has been under improvement by the General Government since 1881 and is, therefore, not a new work. The original project under which improvements were carried on since that year was based upon a survey made by Col. Wm. P. Craighill, Corps of Engineers, in October, 1879. The project was completed in 1889, a channel having been made 50 feet in width and 6 feet deep at mean low water, from a point near Bethel, Del., to Laurel, Del., at the head of navigation, a total distance of about 3 miles. The total amount expended was $35,000. The original depth of water at low tide was only 2 feet at Laurel and only 1½ feet below this town.

The remarkable growth of the town of Laurel is attributed to the increase in commerce on the river, resulting from the improvements made in the channel. Its population has increased from 1,180 in 1880 to 2,367 in 1890. The value of real estate in the town has increased 400 per cent.; that of property along the river front 500 per cent. since the river has been improved.

There are now 6 vessels, from 100 to 150 tons burden each, trading regularly from Laurel, besides about 25 vessels of smaller capacity. A steamer of 45 tons burden runs daily between Laurel and Sharpstown, connecting at the latter point with the steamers of the Nanticoke Steamboat Company, which sail from and to Baltimore. Baltimore is the home market and the shipping point for nearly all the grain and fruit raised in this part of the county. It is said that arrangements will be made in the coming spring for the establishment of another steamboat line.

The shipments and receipts by water at Laurel during the fiscal year ending June 30, 1890, amounted to 34,716 tons, valued at $926,510, notwithstanding the almost entire failure of the grain and fruit season.

The dredged channel shows no signs of deterioration. Very little, if any, material has washed back from the banks thrown up by the dredge, and very little sediment is swept in from the mill ponds at the head of the river.

It is the desire of the people at Laurel to have the present channel widened to about 70 feet and deepened to 8 feet below mean low water. This improvement would cover no other portions of the river that have not already been improved, and as the river has lately been examined, no further survey is necessary if the improvement is recommended.

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

Gen. Wm. F. Smith,
United States Agent.

SUPPLEMENTARY REPORT.

United States Engineer Office,
Wilmington, Del., March 18, 1891.

General: In compliance with instructions contained in Department letter of November 22, 1890, I have the honor to submit a final report, with project and estimate, for the improvement of Broad Creek River (formerly Broad Creek), Delaware, with the view of dredging the present channel between Laurel and Bethel, Del, to a depth of 8 feet below mean low water and to a width of 70 feet.

The channel has previously been improved by the Government, and has now an average depth of 6 feet and a minimum width of 50 feet, but the commercial interests at Laurel demand an enlargement as above to keep step with the rapid increase of commerce at that place.

The lines of the proposed channel are shown on the accompanying map, and follow as nearly as possible the direction of the present channel. The water way is considerably contracted by the railroad bridge at Laurel, which has a draw only 40 feet wide. Although the bridge is so near the head of the river and therefore does not interfere much with the progress of the tide and its contingent currents, it would seem proper nevertheless to require the removal of part of the embankment recently filled in north of the draw to restore the former cross section of the river at that point in conformity with the new project.

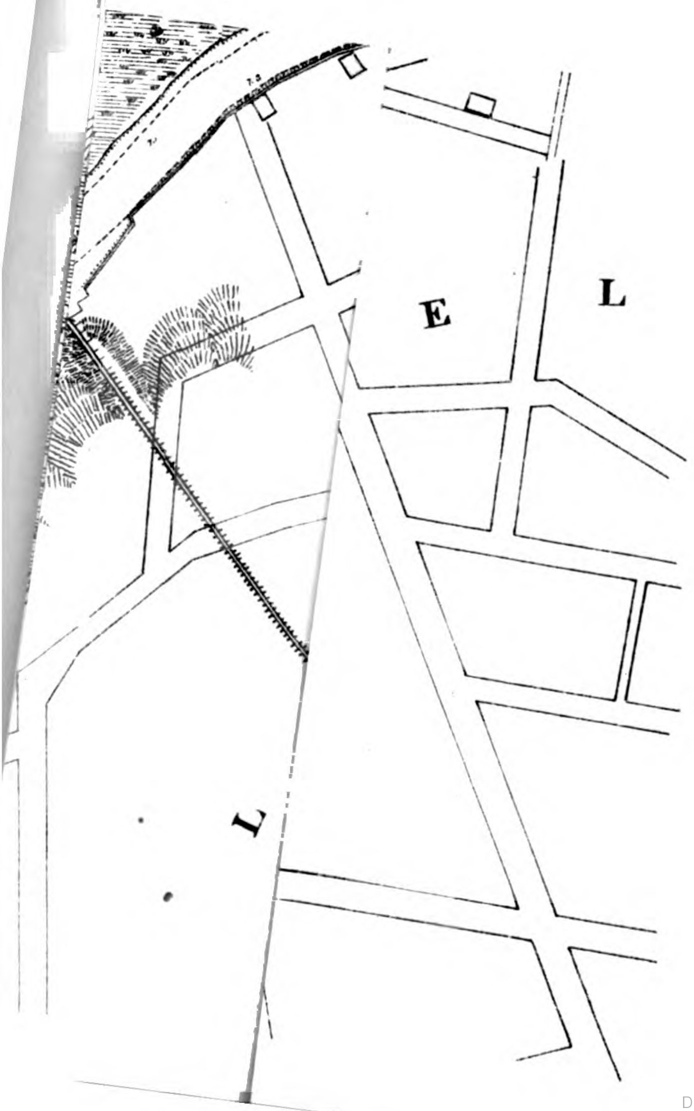
The estimated cost of the project is:

Dredging 75,000 cubic yards of sand and mud, at 20 cents	$15,000

Very respectfully, your obedient servant,

Wm. F. Smith,
United States Agent.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.
(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)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[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., April 2, 1891.

Respectfully submitted to the Chief of Engineers.

The commercial value of the past improvement of this stream having been proved by the facts set forth in the preliminary report of the local engineer, dated November 13, 1890, its continuance to the extent and cost and in the manner suggested in the report of the same officer of March 18, 1891, seems reasonable and proper, and is recommended for approval.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

H 25.

PRELIMINARY EXAMINATION OF TURNER CREEK, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 15, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Turner Creek, Maryland, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts, and for the reasons given in the report of the assistant, a copy of which is herewith inclosed, Turner Creek, Maryland, is considered worthy of improvement, and I recommend a survey of it.

The least amount required to make the survey and report, with project and estimate of cost of improvement, is $200.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.
(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division).

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 17, 1890.

Respectfully submitted to the Chief of Engineers.

So long as no definition is given by Congress or other competent authority of the meaning of the term "worthy of improvement," it can only be inferred from the acts of Congress as to the character of the works for which appropriations have been given in the past. Having in view the statement just made and the facts and reasons given by the local engineer in his report of December 15, 1890, and the present and prospective needs of commerce, I have to state, as required by the river and harbor law of September 19, 1890, that Turner Creek, Maryland, is worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 15, 1890.

SIR: In compliance with your instructions, I have the honor to submit the following report upon the preliminary examination of Turner Creek, Maryland.

Turner Creek is in Kent County, Md., and is a short prong or branch of the Sassafras River, flowing into the latter in a northerly direction, its mouth being about 7 miles east of Howell Point. The creek is about 1½ miles long, and although its width is in some places as much as 2,500 feet, three projecting long tongues of land, two on the west shore and one on the east shore, reduce it at these points to about one-eighth of a mile.

The average depth inside the creek is 4 feet; the average rise and fall of the tide about 2 feet.

As the improvements asked for concern only the section of the creek directly at the mouth, no detailed examination of the upper section was made. It appears that the entrance is much obstructed by a long, narrow point protruding from the east shore and extending at right angles across the mouth. This point is growing in length, and has now encroached upon the channel to such an extent as to almost close it, although the reduction in the width of the channel has been followed by a great increase in depth, which is said to be in some places as much as 40 feet. The channel has been gradually forced close under the opposite banks, which are high and very irregular; the consequence is that its course has become very crooked and full of sharp turns, which follow each other rapidly, so that vessels using it are in constant danger of running aground. The length of the channel thus obstructed is not over 1,000 feet. Beyond this narrow entrance the creek forms a wide, sheltered sheet of water, with an average depth of about 6 feet. This is the harbor, which extends to Turner Landing, one-fourth mile above. There is no navigation above this wharf, which is located on a point of land projecting from the west shore, and which is the only landing in the creek. The country around Turner Creek is a most productive and fine farming region. About 30 farms, averaging 200 acres each, depend upon this creek for a shipping point by water, and the boats of the Sassafras River Steamboat Company stop here twice each day, except in dark nights or on days when strong northerly winds prevail, when they find it difficult, and often impossible, to enter the creek. This uncertainty of communication has prevented the landing from being available at all times, which it otherwise would be. For this reason many farmers prefer to haul their produce and other freights to and from Betterton Landing, 9 miles west, or to Shallcross Landing, 7 miles east from the head of Turner Creek, both being situated on the Sassafras River. Baltimore is the home market for the country around the creek.

During the fruit season an extra steamer besides the daily boat, runs to Baltimore, and also another to Philadelphia, via the Delaware and Chesapeake Canal; both stop at Turner Wharf. One schooner, of about 40 tons burden, makes regular trips throughout the year from and to Baltimore; other sailing vessels, not owned on the creek, occasionally call for a cargo of grain, etc.

The following statement with reference to the shipments made at Turner Wharf was obtained. The peach crop of the past 2 years has been a total failure; during the season of 1888, however, 36,000 baskets of this fruit were shipped; in previous years as much as 60,000 baskets. The shipments in grain, which in former years annually amounted to 100,000 bushels, were last year—an unpropitious season—only 60,000 bushels. There were received as freight during 1889 500 tons of phosphate and coal, besides a large quantity of lumber, flour, salt, and provisions. The steamboat company estimates the value of the freight received and shipped at $20,000 per annum, which includes farming implements, merchandise, asparagus, potatoes, tomatoes, cattle, sheep, hogs, and poultry, and the number of passengers carried at 600. The farmers of the vicinity have begun the cultivation of pease on a large scale, the canning of which promises to become quite an industry.

About 4 miles due south from Turner Wharf is the village of Kennedyville, a station on the Baltimore and Delaware Bay Railroad, with about 200 inhabitants, 3 stores, 1 cannery, and 1 creamery. The people are anxious to have a reliable and convenient water communication established with Baltimore, and together with the farmers have petitioned for the removal of the obstruction at the mouth of Turner Creek. In 1884, private parties had the channel dredged at an expense of $1,400, and about 4,500 cubic yards of material were removed, which for some time thereafter gave considerable relief, but the point of land above described is increasing again in length and threatens to reduce the width of the channel to that of a mere drain.

The point is evidently the accretion of material brought down the shore during northeasterly winds. The high banks of the Sassafras River east of the creek are constantly being undermined by the waves, and large quantities of material, mainly sand and clay, slide into the river. The proper remedy would be to correct the movement of this débris along the shore, by a spur jetty built a short distance above the mouth of Turner Creek, and then to straighten and widen the present channel at the junction with the Sassafras River. It is difficult to estimate, even approximately, the extent and cost of such a project without a chart which would clearly show the present condition of the locality, and a survey is necessary, which can be made for $200.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

SURVEY OF TURNER CREEK, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 20, 1891.

GENERAL: In compliance with Department letter dated December 20, 1890, I have the honor to report upon the survey of Turner Creek, Maryland, made under my direction in April, 1891, as follows:

It seems that the difficulty attending a free navigation to the steamboat landing on this stream is occasioned by a long point of land projecting across its mouth on the east side, causing such an abrupt turn in the channel that it is often impossible, during high winds, for the boats to reach the wharf.

As a relief, I would recommend the dredging of a portion of the point referred to, and, to prevent the drifting of sand from east to west, to place near the entrance a spur dike of piling and brush fascines 400 feet long, as shown on the map of the survey,* which is forwarded in a separate package.

This would require the removal of 12,800 cubic yards of material at 20 cents per cubic yard, $2,560, and the construction of 400 linear feet of pile dike at $3.75 per foot, $1,500; a total of $4,060.

The benefit to be derived from the proposed improvement would be great in comparison with the small amount of expenditure.

A copy of the report of Mr. A. Stierle, assistant engineer, is herewith transmitted.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., July 22, 1891.

Respectfully submitted to the Chief of Engineers, and recommended for approval.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

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* Not printed.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 18, 1891.

SIR: I have the honor to submit herewith a report upon the survey of Turner Creek, Maryland, and a project for the improvement of the same.

A report on a preliminary examination was submitted on December 15, 1890, and for information as to the benefit to commerce and navigation which would result from the improvement of the creek, I would respectfully refer to that paper.

The survey was made during the month of April last, and embraced principally the obstructions existing at the mouth. The shore line on each side of the creek from Turner Wharf out into and along the Sassafras River for some distance east and west of the mouth, was located by triangulation and with the stadia rod; and the hydrography within this section was filled in along fixed range-lines, locating the soundings at stated intervals by transit angles from the shore.

To avoid any inaccuracy in establishing the important mean low-water plane by a few days observations only, the tidal record at Turner Wharf was continued after the survey had been completed until the whole series of observations embraced an entire lunar month of 28 days. The average rise and fall of the tide for the month was 2.34 feet. The highest high water occurred during easterly and southerly strong winds, when it rose in two instances to the same level, 3.06 feet above the mean. The lowest low water occurred during a strong northwesterly wind, when it fell 1.23 feet below the mean. The greatest range observed is, therefore, 4.3 feet. A bench-mark was fixed on the wharf near the gauge to establish the mean low-water plane permanently.

The object of the desired improvement is to secure a safer entrance to the creek during the prevalence of northerly or easterly winds. The mouth of the creek, which has ample depth of water, is considerably contracted by a long point of land of comparatively recent formation which projects across it on the east side as a continuation of the south shore of the Sassafras River. It is very difficult in rough weather to navigate around this point on account of the sharp turn in the channel, and the steamers in consequence often fail to make a landing. This can be remedied by removing, by dredging, a portion about 200 feet wide of the point, to give more width where the channel deflects, and by constructing a short pile dike on the east side of the entrance to stop the drift of sand from east to west along the shore. This plan is for a permanent improvement. To dredge the point is only a temporary relief, as has been proved by the dredging done here by private parties in 1884. The proposed dike is, as is shown on the accompanying chart, a rough and cheap structure of pine piling driven alternately right and left of an imaginary space along the axis of the dike, the space between the piles, which is about 9 inches, to be closed longitudinally with brush fascines extending from the bottom to high-water level. At about the same plane and throughout the whole length of the dike, the heads of the piles are connected by a central strip of timber bearing directly upon the fascines and by two wale pieces spiked against the outer faces of the piles, which need not, however, extend any further than from the outer end of the dike to about the 4-foot contour.

The dredging at the point and the construction of the dike should be carried on simultaneously. The drift material which now accumulates at the point would be arrested by the dike and would be deposited instead within the re-entrant angle on the east side, and the dredged material could, for the protection of the dike, be hauled to and dumped on both sides of the shore end.

The direction given the dike is such that its proposed length, or a possible extension of it, will aid in maintaining the present depth of water over the bar.

Estimates.

Dredging 12,800 cubic yards, at 20 cents	$2,560
400 lineal feet of pile dike, at $3.75	1,500
	4,060

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 26.

PRELIMINARY EXAMINATION OF LA TRAPPE [RIVER], MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 13, 1890.

GENERAL: In compliance with the instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of La Trappe River, Maryland, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts, and for the reasons set forth in the report of the assistant engineer, a copy of which is herewith inclosed, La Trappe River, Maryland, is in my opinion worthy of improvement, and a survey is recommended.

The least amount required to make the survey and report with project and estimate of cost of improvement is $300.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.
(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer, I agree with him that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 13, 1890.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of La Trappe River, Maryland.

A preliminary examination of this river was also made in December, 1888, in compliance with the requirements of the river and harbor act of August 11, 1888, and the report is printed in the annual report of the Chief of Engineers for 1889, pages 920 and 921.

The examination made this time has evolved no new data that could be added to the report made nearly two years ago; that report is therefore repeated below. The citizens of Trappe have since then, during the summer of 1889, expended an additional sum of $2,100 in dredging at the bar and at the head of the river, subsequently to which larger steamers commenced running into the river. The channel, however, though much improved, was still too narrow; the steamers were compelled to go slowly, which caused considerable loss of time, and they were soon thereafter withdrawn from this portion of their route.

La Trappe River is in the lower section of Talbot County, Md., and flows in a southwesterly direction into the Choptank River. It is a small stream, about 3 miles long, with no drainage area back of it, and is simply one of those innumerable short prongs, or lateral branches, characteristic of the Eastern Shore of Maryland, that project for a short distance into the shores at the larger rivers and are governed entirely by the tide. The name of the river was formerly Dividing Creek, the change having been made by act of the State legislature.

The rise and fall of the tide is said to be about 2 feet. The average depth of water in the channel is about 6 feet at mean low water as far as Trappe Landing, the head of navigation. There is a narrow and winding channel across the bar at the mouth with an average depth of 6 feet at mean low tide, and having a hard, sandy bottom.

Navigation across it is very difficult and often impossible when low tide, and high winds prevail. The first public landing, Barnet's Wharf, is about 1 mile above the mouth; the next is Trappe Landing, near the head of the river and about 1¼ miles from the town of Trappe. Within the last section the river is quite shoal. These landings are used mainly by two lines of steamers that stop here four times per week during the winter and daily during the summer season. Three sailing vessels, of a carrying capacity of 5,000 bushels of grain each, also sail in and out of the river regularly.

The country along the La Trappe is a fine farming region, the second in fertility and population in Talbot County. The town of Trappe has about 400 inhabitants, one gristmill, and one sawmill in town, and seven sawmills in the immediate vicinity.

The geographical position of the place is a favorable one, since it is not more than 5 miles distant in any direction, except due north, from large, navigable streams. Trappe Landing is, nevertheless, the nearest and most convenient one for the surrounding district, it being the last stopping place for steamers plying up the Choptank and elsewhere on their return trips to Baltimore, thus giving ample time for the hauling of produce to the wharf and reducing the time consumed in transporting perishable freight to market.

It is stated that the amount of shipment by rail and water during the past year to and from the Trappe district was as follows: 100,000 bushels of grain, 21,000 baskets of peaches and apples, 600 tons of coal, 5,000 bushels of lime, 1,000 tons of fertilizers, 3,000 bushels of oyster shells, 168,000 pounds of lamb, 235,000 pounds of poultry and fish; machinery and implements, to the value of $2,000; live stock, $68,000, and general merchandise, $260,000.

In the year 1884 the citizens at and near Trappe raised by subscription the sum of $3,233.50 for the purpose of improving the channel to Trappe Landing, which had then an average depth of only 4 feet. This sum was expended principally within the upper mile of the river in making a channel about 40 feet wide and 8 feet deep. The channel across the bar was also straightened somewhat. These improvements were of great benefit to the surrounding country and resulted in greatly increased shipments. They were, however, wholly inadequate to the requirements of navigation, and the desire has been expressed to have a channel dredged 10 feet deep at mean low water, 100 feet wide across the bar at the mouth, and 60 feet in width within the remainder of the river as far as Trappe Landing. It is supposed that if the present obstructions are removed shipments of all kinds will increase 100 per cent.

A survey of the river, if recommended, can be made for $300.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. W. F. SMITH,
United States Agent.

SURVEY OF LA TRAPPE [RIVER], MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 30, 1891.

GENERAL: In compliance with instructions contained in Department letter of November 22, 1890, I have the honor to submit the following report upon the survey of La Trappe River, Maryland, made under my direction in May, 1891.

The improvement proposed is to dredge a channel 11 feet deep at mean low water and 150 feet wide across the bar at the mouth, and to enlarge the present low-water channel of the river, so that it will be not less than 75 feet wide and 8 feet deep from the mouth to Trappe Landing.

The estimated cost of the improvement is $7,250. A copy of the report of Mr. A. Stierle, assistant engineer, is herewith transmitted, and a tracing of the map of the survey* is sent by mail in a separate package.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., August 1, 1891.

Respectfully forwarded to the Chief of Engineers.

The proposed project is recommended for approval.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 27, 1891.

SIR: I have the honor to submit herewith a report upon the survey of La Trappe River, Maryland, and a project for the improvement of the same.

A report on a preliminary examination was submitted on November 13, 1890, and for information about the benefit to commerce and navigation which would result from the improvement of the river, I would respectfully refer to that report.

The survey was made during May last, and embraced the topography and hydrography of the river from a point 1,000 feet above Trappe Landing to deep water in the Choptank River, a total distance of nearly 4 miles. Tidal observations were made from April 22 until May 26 at Trappe Landing and at Seymour's Wharf, near the mouth. The average rise and fall of the tide during the month was found to be practically the same at both points, viz, 1.55 feet.

The lowest low water observed fell 1 foot below and the highest high water rose 3.7 feet above mean low water, making the greatest range observed 4.7 feet. The uniformity in the tidal characteristics of both stations, which are situated over 3 miles apart, makes it appear that the bed of the river must be little obstructed by bars and is generally in a good condition. The accompanying chart shows this.

The desired improvement is for a wide and slightly deeper channel across the bar at the mouth, and for a wide channel near Trappe Landing. In ordinary weather the depth of water at both places is sufficient for vessels of such draft as navigate on this river; during stormy days, however, and during low tides the limited width in the channel is a great obstacle to navigation.

The channel at the mouth has three distinct characteristic features: An outer bar with a minimum depth of 10¼ feet at mean low water; a deep-water pocket over 16 feet in depth, and an inner bar where the least depth of water is 9 feet. The course of the channel is very tortuous, and is nearly ½ mile long. The remedy suggested is to dredge a channel 150 feet wide to a depth of 11 feet at mean low water across the inner bar. The length of the cut will be about 700 feet. It is believed that the channel at the outer bar is of ample dimensions for existing needs.

The channel within the upper section of the river is to be widened to 75 feet and to be dredged where needed to a depth of 8 feet below mean low water. The length of the channel to be improved here is about 3,700 feet, and extends from Connollys Cove to the upper end of Trappe Landing. A turning basin 200 feet wide at the latter place is included.

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*Not printed.

The improvements last recommended will be undoubtedly more permanent than those proposed for the mouth of the river. Probably one winter's season will restore the channel at the bar after being dredged to its original condition, unless protective works are built, the expense for which, however, is not warranted by the present and prospective commerce of the river.

Estimates for dredging.—At the mouth of the river, 10,000 cubic yards; at and below Trappe Landing, 19,000 cubic yards; total, 29,000 cubic yards at 25 cents, $7,250.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 27.

PRELIMINARY EXAMINATION OF WARWICK [RIVER], MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 13, 1890.

GENERAL: In compliance with the instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Warwick River, Maryland, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts and for the reasons set forth in the assistant's report, a copy of which is herewith inclosed, Warwick River, Maryland, is in my opinion worthy of improvement, and a survey is recommended.

The least amount required to make the survey and report with project and estimate of cost of improvement is $200.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer, I agree with him that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 13, 1890.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of Warwick River, Maryland:

A preliminary examination of this river was also made in December, 1889, in compliance with the requirements of the river and harbor act of August 11, 1888, and the report is printed in the Annual Report of the Chief of Engineers for 1889, pages 919 and 920.

The examination made this time has evolved no new data that could be added to the report made nearly two years ago; that report is, therefore, herewith repeated.

Warwick River is in Dorchester County, eastern shore of Maryland, and flows in a due westerly direction into the Choptank River.

Its total length is not over 3 miles. The width across the mouth is about 1,000 feet; within the river it is from 200 to 600 feet.

The name of this stream was until quite recently Secretary Creek, the change having been made by act of the legislature of the State of Maryland. There is little head water, as the drainage area is small, and the rise and fall of the tide is said to be about 2 feet. The principal landing on the river is about 1½ miles from its mouth, to which the present channel and navigation extend.

This river was surveyed in the year 1879, under the direction of Col. William P. Craighill, Corps of Engineers, and estimates were subsequently submitted for a 7-foot channel, 75 or 100 feet wide, and for an 8-foot channel 75 or 100 feet wide, up to the town wharf.

Two appropriations were made for its improvement, of $3,000 each, in 1879 and 1881, respectively, and at the close of operations in the latter year a clear channel 7 feet deep at mean low water and nowhere less than 100 feet wide existed from the mouth to the town wharf.

This channel was originally very narrow and tortuous and its depth was not over 4 feet. The improvement was so much needed that in 1887 the sum of $6,000 was raised by private subscription and expended in straightening and deepening the channel. This, in addition to the two appropriations subsequently made by Congress, makes so far a total expenditure of $12,000 for the improvement of the river.

The river has an area of rich, productive, and thickly populated country, 10 miles square, depending upon it for shipping facilities. Within this area are situated the towns of East New Market, Cabin Creek, Ennall, Crotchers Ferry, Vienna, Salem, Lickwood, Warwick, Harrison, and Hurlock. It is a large commercial center, and business and trade of all kinds are growing rapidly. The passenger business from the river is large and the output, as near as can be approximated, is as follows:

200,000 bushels of grain, valued at	$150,000
200,000 cases canned fruit, valued at	175,000
300,000 packages fruit and vegetables, valued at	200,000

Fish and oysters, as well as stock and miscellaneous products, can not be estimated. The value of general merchandise which supplies these towns is very large, and would be difficult to approximate. The packing house gives employment to over 100 small vessels during the oyster season. Large vessels come in to bring ice and take away lumber, ship timber, etc.

The above data were kindly furnished by the Choptank River Steamboat Company, who consider this river one of the best shipping points on their line. Their steamers land here daily unless prevented by very low tides or high winds. When these prevail navigation is often interrupted for several days.

It is stated that the channel across the bar and inside the river has filled in somewhat, and is entirely inadequate to the requirements of a safe and unobstructed navigation. The desire is that it should be deepened to 12 feet at mean low water, and that it should be made not less than 100 feet wide.

A survey, if recommended, would cost $200, and would be valuable for comparison with the one made in 1879.

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

Gen. W. F. Smith,
United States Agent.

SURVEY OF WARWICK [RIVER], MARYLAND.

United States Engineer Office,
Wilmington, Del., August 17, 1891.

General: In compliance with instructions contained in Department letter of November 22, 1890, I have the honor to submit the following report upon a survey of Warwick River, Maryland, made under my direction in the months of May and June, 1891.

The project for improvement is for a 10-foot low-water channel, 100 feet wide, from the Choptank River to the wharves.

Appropriations by the General Government of a total of $6,000 have already been expended in improving this river, and the channel as then made has certainly proved of great benefit to shipping. There can be no doubt that with further improvements, extended as required by the present demands of commerce, these benefits would be much enhanced.

The estimated cost of the improvement, which would require the removal of 93,000 cubic yards of material at 20 cents per cubic yard, is $18,600.

A copy of the report of Mr. A. Stierle, assistant engineer, is herewith transmitted, and a tracing of a map of the survey is forwarded by mail to-day in a separate package.

Very respectfully, your obedient servant,

Wm. F. Smith,
United States Agent.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. Engineer Office,
Baltimore, Md., August 20, 1891.

Respectfully submitted to the Chief of Engineers.

The project is to increase the dimensions of the channel already made by the United States for the accommodation of the increased business of this stream, by deepening and straightening it where necessary, so that it may be 10 feet deep and 100 feet wide at low water, the former depth having been 7 feet.

The project is recommended for approval.

Wm. P. Craighill,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

United States Engineer Office,
Wilmington, Del., August 13, 1891.

Sir: I have the honor to submit herewith a report upon the survey of Warwick River, Maryland, and a project for the improvement of the same.

A report on a preliminary examination was submitted on November 13, 1890, and for information relative to the benefit to commerce and navigation which would result from the improvement of the river, I would respectfully refer to that report.

The survey was made during the latter part of May and in the beginning of June last, and embraced the topography of the shores and the hydrography of the river from Secretary Landing to deep water in the Choptank River, a total distance of about 2 miles. A tidal station was established at the wharf of the Maryland Steamboat Company, near the head of the river, and observations made for 18 days. As the days were long, some of the observations were made as early as 4 a. m. and as late as 9 p. m. and thus a record of 22 low waters and 24 high waters was obtained from which the low and high water planes, for the time being, were determined. The average rise and fall of the tide was found to be 1.70 feet. The lowest low water observed fell 0.87 feet below and the highest high water rose 2.93 feet above the plane of mean low water, giving as the greatest range observed 3.80 feet.

The survey shows that the channel dredged in 1877 at an expense of between $4,000 and $5,000, a fund raised by subscription, and in 1881, under two appropriations of $3,000 each made by Congress, has maintained itself remarkably well. The dredging was done to a depth of 7 feet below mean low water and for a width of 100 feet. The present survey shows a continuous depth of 9 feet in a very narrow trough in the channel from the Choptank River to the landing at the head of the river, a depth which is probably due to the action of the propellers of the deep-draft steamers that pass daily in and out of the river. These boats are now of much deeper draft and are generally of greater carrying capacity than 10 years ago, the increased dimensions being a direct result of the increase in shipping and commerce of the river. The present channel has, therefore, for some years back been found entirely inadequate for safe navigation, especially in stormy weather, and needs enlargement both in width and depth.

The project for improvement is a very simple one. The main features are, to straighten the present channel as much as possible, particularly at a point just inside the mouth of the river, where, on account of the sharp turn located here, the boats often run aground, and to give sufficient width and depth to allow for low tides that generally prevail during northerly winds. The steamers which enter the river daily draw over 8 feet of water at the stern. Allowing for suction under the keel and for low tides, the depth required to facilitate navigation should not be less than 10 feet at mean low water. This depth and a channel width of 100 feet has been provided for in the estimate given below.

In view of the experience gained since the former improvements were completed, it is safe to say that the proposed improvements will be quite permanent and will go far towards removing the obstacles which heretofore prevented one of the best shipping points on the eastern shore of Maryland to be accessible at all times.

ESTIMATE.

Dredging a channel 100 feet wide and 10 feet deep at mean low water, from the 10-foot depth in the Choptank River to Secretary Landing, including a turning basin at the latter point:

Ninety-three thousand cubic yards, at 20 cents per cubic yard, $18,600.

Very respectfully your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 28.

PRELIMINARY EXAMINATION OF BROAD CREEK, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., October 14, 1890.

GENERAL: In accordance with the requirements of the river and harbor act of September 19, 1890, and the instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Broad Creek, Maryland, made under my direction by Mr. A. Stierle, assistant engineer, and a copy of his report is inclosed.

From a personal examination of the locality and for the reason and facts given in the report of the assistant, I am decidedly of the opinion that the water way known as Broad Creek, Maryland, is worthy of improvement, and recommend a survey of it. An approximate estimate of the cost of the improvement is $20,000.

The least amount required to make the survey and report, with project and estimate of cost of improvement, is $300.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer I agree with him that this creek is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., October 13, 1890.

SIR: In accordance with your instructions I have the honor to submit the following report upon the preliminary examination of Broad Creek, Maryland:

There are three creeks of that name on the eastern shore of Maryland, and perhaps more in the other parts of the State; the one in question was finally located with the assistance of the representatives of Congress.

This Broad Creek is a few miles south of Crisfield, Somerset County, Md. It is not a creek in the true sense of the word, but a narrow "thoroughfare," winding through the marshes of Watkins Point, opening north into Little Annemessex River and south into Pocomoke Sound. Its total length is about 2¼ miles.

The southern half of the creek is from 1,000 to 1,800 feet wide; the width of the other half varies between 200 and 500 feet. It has a distinct narrow channel from 75 to 150 feet wide, flanked on either side in the wider portions by extensive shoals. At both outlets the depth of water, which inside the creek varies from 5 to 12 feet, is reduced by bars to about 1½ feet at the northern end and 7 feet at the southern end, both referring to mean low water. The average depth of the creek throughout may be 5 feet; the greater depths are found in the southern or wider portion, which opens into Pocomoke Sound. The bottom is sticky mud, which is slightly covered with fine sand at and near the mouth into Annemessex River. The tide rises about 2 feet, and the adjacent marsh is about 1 foot above high-water level.

This thoroughfare is at present used by small boats only, on account of the shoal bar at the northern end. The number of boats drawing not over 3 feet of water which avail themselves of this water passage at high water is, however, very large. It is the desire of those interested in the navigation of the adjoining rivers and bays, whose commerce centers in the city of Baltimore, to have the thoroughfare improved and deepened, so that all vessels of the class now in vogue on the eastern shore that draw over 3 feet of water can pass through Broad Creek at all stages of the tide. The improvement would especially benefit all sailing vessels trading, fishing, and carrying oysters from the Pocomoke Sound to Crisfield and to Baltimore, and for those going in an opposite direction. In addition, the steamers of the Eastern Shore Steamboat Company, which stop at numerous landings in almost every river and creek on this shore that flows into the Chesapeake Bay, from the Big Annemessex on the north to the Cherrystone Creek on the south would make considerable saving in time if they were enabled to go through Broad Creek on their route between Crisfield and Snow Hill, Md. The distance between these towns by water would be shortened 26 miles, which is equal to about 2 hours' run by steamer. The present course follows Tangier Sound to and around the lower end of Watts Island and up the Pocomoke Sound. This course is 32 miles long, beginning in Little Annemessex River at a point opposite the northerly outlet of Broad Creek to a point in Pocomoke Sound just opposite the southern outlet, and must be taken by all vessels drawing over 4 feet of water in order to avoid the extensive and dangerous shoals which for 9½ miles extend in a straight line due south from Watkins Point.

The shortening of this course, as indicated, would not be the only point of advantage to be gained by navigation. During the prevalence of gales or high winds from the points of the compass from north around by west to south, the smaller class of vessels, which embraces by far the greatest number frequenting these waters, are compelled to lay "under the land" as it were, until the wind has subsided before they can risk the dangers of Tangier Sound. If Broad Creek was opened, only during a very severe southerly gale probably would these vessels be prevented from passing from Pocomoke Sound to Little Annemessex River or *vice versa*.

As is well known, these waters are alive during the oyster season with boats and vessels engaged in that business ranging from 5¼ to 75 tons burden.

The number and tonnage of boats trading and sailing regularly to and from the neighboring shores all the year round is also very large. It is stated that in the number of vessels registered, Crisfield is the fifth largest port of entry in the United States. During the past fiscal year about 900 vessels were registered here of a total of 20,000 tons burden. The annual increase in numbers is about 50. The size of the vessels is comparatively small, averaging about 40 tons. Some of the largest, however, have a draft of 8½ feet.

The greater number of the oyster vessels registered at Onancock, which is one of the harbors in the collection district of Cherrystone, embracing the west shores of Accomac and Northampton Counties, Va., have direct business relations with the large oyster packing houses at Crisfield. To these vessels, about 300 in number, the majority of which work on the oyster beds in Pocomoke Sound, the improvement of Broad Creek would be of great value.

The physical conditions of the creek are most favorable for an economical improvement. The material of the bottom and the banks is soft, yet sufficiently tenacious to prevent the currents and the sea from having any destructive effects upon the same. The direction of the thoroughfare is nearly coincident with that of the set of the tide in both directions which prevails in the adjoining sounds, and therefore it may be safe to assume that the improvement, if once made, would be permanent in character. A channel 125 feet wide and 7 feet deep at mean low water dredged from the Little Annemessex River to Pocomoke Sound, and following the present channel in Broad Creek as much as possible, would probably cost $20,000.

In this improvement are directly interested the counties of Northampton and Accomac, in Virginia, and the counties of Somerset and Worcester, in Maryland, all having close commercial relations via Chesapeake Bay with the city of Baltimore. A recital of commercial statistics of all the towns and rivers embraced in this district would be too voluminous, and is therefore omitted. The reference made above, as to the number of vessels engaged in navigation in this locality, may serve as a basis, however, to measure the extent of this commerce.

It is estimated that a survey of Broad Creek, if ordered, can be made for $300.

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

Gen. W. F. Smith,
United States Agent.

SURVEY OF BROAD CREEK, MARYLAND.

United States Engineer Office,
Wilmington, Del., August 31, 1891.

General: In compliance with instructions contained in Department letter of November 22, 1890, I have the honor to submit the following report of a survey of Broad Creek, Maryland, made under my direction in accordance with the requirements of the river and harbor act of September 19, 1890.

The project for the improvement of this locality as developed by the survey and fully set forth in the report of Mr. Stierle, assistant engineer, and which I recommend, embraces a 7-foot low-water channel 120 feet in width from the 7-foot depth in Pocomoke Sound to the same depth in Little Annemessex River.

This will require the removal of 270,000 cubic yards of material at an estimated cost of 20 cents per cubic yard, a total of $54,000.

A copy of the report of the assistant engineer is herewith transmitted, and a tracing of the map* of the survey is forwarded by mail to-day in a separate package.

Very respectfully, your obedient servant,

Wm. F. Smith,
United States Agent.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

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*Not printed.

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., September 8, 1891.

Respectfully submitted to the Chief of Engineers, and the project recommended for approval.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., August 28, 1891.

SIR: I have the honor to submit herewith a report upon the survey of Broad Creek, Maryland, and a project for the improvement of the same.

The report on a preliminary examination submitted October 13, 1890, contains all the information necessary relative to the benefits that would accrue to commerce and navigation if this creek was improved, and I would respectfully refer to it in connection with the present report.

This creek is an open "thoroughfare" across a wide piece of marsh and connects Pokomoke Sound with Little Annemessex River.

The survey was made during the month of July last and embraced the hydrography of the creek between the 7-foot depths in the sound and the river just mentioned, a distance of over 2 miles. The average depth was found to be less than was anticipated, and the general course of the channel is quite irregular, with several abrupt turns. A greater depth and width prevails at the lower or Pocomoke end, the junction with the main channel in the sound being little obstructed. At the upper end, however, the drift sand in Little Annemessex River has almost closed the present outlet, the bottom being sandy and flat and nearly dry at very low tides. The character of the bottom throughout the creek is soft and sticky mud with a few spots of fine loose sand in the deeper portions of the channel.

Observations of the tides were made at both outlets of the creek, at the north end for 34 days and at the south end for 13 days. The latter station was established to determine in connection with the other station whether the tidal wave entered the creek from Pocomoke Sound or from the Little Annemessex River, or from both ends simultaneously, and whether the currents have any decided set in any particular direction. Sufficient observations were obtained to elicit the fact that the tidal wave as it passes up Chesapeake Bay enters the creek from the Pocomoke Sound, and passes on through to the Little Annemessex River. Its velocity is so slow, however, that the high-water crest consumes on an average 49 minutes and the foot of low water 31 minutes to travel from the southern to the northern outlet over the intervening distance of 2 miles. The prevailing strongest currents are in a southerly direction during ebb tide, which explains the better developed channel in the lower or southern portion of the creek. The average rise and fall of the tide as determined by the observations on the gauge at the northern outlet is 1.92 feet. The highest high water rose 2.78 feet above and the lowest low water fell 0.57 feet below the mean low water level during the period of observations, giving as the greatest range observed 3.35 feet. The weather throughout was comparatively calm and settled.

Since the survey has been made more than the usual interest has been shown in the proposed improvement, which would undoubtedly be of great benefit to the oyster fleet in Tangier and Pocomoke Sounds and to navigation generally. The projected channel follows as nearly as possible the existing deep water in the creek and is of sufficient dimensions to permit, at low water, the passage of such vessels as now ply upon the bay. Although the proposed cut leads at several points through the solid marsh, dredging should be comparatively easy at this sheltered locality and the material can be deposited upon the adjoining banks.

ESTIMATE.

Dredging a channel 120 feet wide and 7 feet deep at mean low water from the respective depth in Pocomoke Sound to that in Little Annemessex River, 270,000 cubic yards, at 20 cents	$54,000.00

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 29.

ESTABLISHMENT OF HARBOR LINES AT NEW CASTLE, DELAWARE.

U. S. ENGINEER OFFICE,
Wilmington, Del., June 18, 1891.

GENERAL: Referring to section 7 of the river and harbor act of September 19, 1890, I have the honor to report that a wharf belonging to Col. H. A. Dupont, of this city, situated within the ice-harbor at New Castle, Del., corners on the harbor line recommended by the U. S. Coast Survey in 1873, and is on its two sides respectively 16 and 18 feet beyond the harbor line laid out in 1873 by the authorities of New Castle under the provisions of law of the State of Delaware.

About 400 feet below the limits of the ice-harbor is an old, unused and dilapidated wharf, supposed to be under the control of the Philadelphia, Wilmington and Baltimore Railroad Company, which extends beyond the harbor line last mentioned respectively 35 feet and 12 feet.

A tracing of the harbor showing the piers and lines above referred to is herewith inclosed.*

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Second indorsement.]

U. S. ENGINEER OFFICE,
Wilmington, Del., June 22, 1891.

Respectfully returned to the Chief of Engineers with recommendation that harbor lines be established within the ice harbor at New Castle, Del., upon the lines adopted in 1873 by the commissioners appointed by the legislature of the State of Delaware, excepting to portion from Jefferson Wharf to Pier B, as shown in broken red line on the accompanying tracing,* which is moved out to embrace the pier recently built.

WM. F. SMITH,
United States Agent.

[Third indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 25, 1891.

Respectfully submitted to the Secretary of War.

W. F. Smith, United States agent, major of engineers, U. S. A., retired, in charge of the work at New Castle, Del., recommends that harbor lines be established by the Secretary of War at that locality; and the accompanying map* of the harbor, having upon it the harbor lines recommended for adoption, is respectfully submitted with recommendation that the harbor lines as shown on the map be approved by the Secretary of War under the provisions of section 12 of the river and harbor act approved September 19, 1890, and that the Secretary place his approval both upon the tracing and this communication.

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*Omitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fourth indorsement.]

WAR DEPARTMENT, *June 26, 1891.*

Respectfully returned to the Chief of Engineers with proposed harbor lines approved as recommended in the preceding indorsement.

L. A. GRANT,
Acting Secretary of War.

APPENDIX I.

IMPROVEMENT OF PATAPSCO RIVER AND CHANNEL TO BALTIMORE, MARYLAND, AND OF JAMES RIVER, VIRGINIA.

REPORT OF COLONEL WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. **Patapsco River and Channel to Baltimore, Maryland.**
2. **James River, Virginia.**

EXAMINATION.

3. **Patapsco River, Maryland, from the Craighill Channel to the sugar refinery wharves, Curtis Bay.**

United States Engineer Office,
Baltimore, Md., July 9, 1891.

General: I have the honor to forward herewith the annual reports for the year ending June 30, 1891, for the works of improvement of rivers and harbors which have been in my charge.

In cases where the commercial statistics may not be as full and complete as desirable it is not for want of desire and effort on my part to have them so.

During the year I have been Division Engineer of the Southeast Division, member of the Light-House Board and of a number of special Boards, including the Board of Officers on production of steel forgings and erection of factories for high-power guns.

Very respectfully, your obedient servant,

Wm. P. Craighill,
Colonel, Corps of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

I 1.

IMPROVEMENT OF PATAPSCO RIVER AND CHANNEL TO BALTIMORE, MARYLAND.

The act of August 11, 1888, appropriated $300,000, with which the improvement was vigorously continued under contract until the end of August, 1889, when operations were brought to a close for want of funds. The depth of the channel was already 27 feet at low water, by which access was afforded to Baltimore by ships of the heaviest tonnage. With this appropriation great improvement in the width of the channel had been made, especially at the angles.

The next appropriation was of $340,000, September 19, 1890, and another of $151,200 March 3, 1891. The former contained the following clause:

> *Provided,* That such contracts as may be desirable may be entered into by the Secretary of War for the completion of the existing project, or any part of same, to be paid for as appropriations may from time to time be made by law.

By advertisement of September 30, 1890, proposals were invited for completing the channel to a width of 600 feet with a depth of 27 feet at mean low water, which were received December 2. The contract was awarded to the American Dredging Company, of Philadelphia, at 10½ cents per cubic yard for removal and redeposit, to cover 6,000,000 cubic yards of material. The time for completion of the work is June 1, 1893.

Under this contract operations were resumed, as soon as the weather would permit, February 17, 1891. Up to the end of the fiscal year there have been removed under the pending contract the following quantities of material:

	Cubic yards.
From the lower division	196, 677¾
From the cut-off division	205, 627
From the Brewerton division	931, 696½
Total amount removed during fiscal year	1, 334, 001¼
Redeposited below Rock Point	355, 678½
Redeposited eastward of the Craighill Channel	978, 322¾

FORT MCHENRY DIVISION.

No work of excavation was done in this division during the fiscal year.

BREWERTON DIVISION.

The area excavated in this division during the fiscal year was 21,000 feet in length and 150 feet in width, and was dredged to a minimum depth of 27 feet at mean low water; of this area, two-thirds was on the south side of the channel and one-third on the north side.

CUT-OFF DIVISION.

The area excavated in this division during the fiscal year was one of 9,060 feet in length and 33⅓ feet in width, and one of 1,940 feet in length and 66⅔ feet in width. All dredging was done on the east side of the channel, and was made to a minimum depth of 27 feet at mean low water.

LOWER DIVISION.

In this division an area of 21,200 feet in length and 50 feet in width was excavated on its west side to a minimum depth of 27 feet at mean low tide.

LENGTH AND WIDTH OF THE SEVERAL DIVISIONS.

Fort McHenry division.—This division from the city of Baltimore to the Brewerton division is 28,500 feet in length, with a width of from 250 to 1,000 feet (the latter at the Fort McHenry angle).

Brewerton division.—The Brewerton division from the Fort McHenry Division to the cut-off division is 23,500 feet in length, its minimum width is 550 feet, and maximum 1,000 feet (at the angles).

Cut-off division.—This division from the Brewerton to the Craighill is 22,100 feet in length, its width is 466⅔ feet for a distance of 1,940 feet, 433⅓ feet for a distance of 9,060 feet, and from 400 to 1,000 feet for the remaining distance; the width of 1,000 feet is at the angles.

Lower division.—This division, which extends from the Cut-off Channel to the deep water in the Chesapeake Bay, is 24,000 feet in length, and has a width of 450 feet for 20,200 feet of its length, 400 feet for 1,000 feet, and from 450 to 1,000 feet for the remaining distance, the width of 1,000 feet being at the angle at its upper end.

Operations having been repeatedly suspended, once for more than a year, since the estimate of December 17, 1886, for the present approved depth and width, the use of the channel in its unfinished condition has caused considerable injury to its sides, and this may increase the ultimate cost somewhat, though it is now believed the work can be completed within the estimate. Moreover, it has always been expected and frequently stated in official reports that for the maintenance of this artificial channel when finished an annual expenditure for repairs will be needed of about $50,000.

A resurvey is now in progress, upon which a revised estimate of the total cost of completion and maintenance will be based.

Money statement.

July 1, 1890, balance unexpended		$45,629.51
Amount appropriated by act approved September 19, 1890		340,000.00
Amount appropriated by sundry civil act approved March 3, 1891		151,200.00
		536,829.51
June 30, 1891, amount expended during fiscal year		99,012.83
July 1, 1891, balance unexpended		437,816.68
July 1, 1891, outstanding liabilities	$3,000.00	
July 1, 1891, amount covered by uncompleted contracts	547,061.54	
		550,061.54

Amount (estimated) required for completion of existing project	208,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	208,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging channel leading to harbor at Baltimore, Md., opened at 12:05 p. m. December 2, 1890.

No.	Name and address.	Price per cubic yard for the whole.	Price per cubic yard for Part A.	Price per cubic yard for Part B.	Price per cubic yard for Part C.	Price per cubic yard for Part D.	Least total.
		Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	
1	National Dredging Company, Wilmington, Del	....	11	9	....	7	$375,000
2	Baltimore Dredging Company, Baltimore, Md	13¾	12	10½	20½	9¼	$821,250
3	Atlas Dredging Company, Wilmington, Del	13½	12	10½	20	9	810,000
4	Moore & Wright, Portland, Me	13⅝	12½	10	21	9	817,500
5	George C. Fobes & Co., Baltimore, Md	$13\frac{9}{10}$	12⅜	10⅜	21	9⅜	834,000
6	P. Sanford Ross, Jersey City, N. J.	13¾	12¼	10½	20½	9¼	824,750
7	Kaufman Simon, New York	$10\frac{85}{100}$	12	11	13½	10½	651,000
8	American Dredging Company, Philadelphia, Pa	10½	....	....	....	....	630,000
9	Morris and Cumings Dredging Company, New York	$13\frac{45}{100}$	12½	10	$20\frac{1}{10}$	9	807,000

Available for contract, $340,000. Contract with American Dredging Company.

Attention is called to the law providing for the completion of this improvement: "*Provided*, That such contracts as may be desirable may be entered into by the Secretary of War for the completion of the existing project, or any part of same, to be paid for as appropriations may from time to time be made by law."

COMMERCIAL STATISTICS.

LETTER FROM THE COLLECTOR OF THE PORT OF BALTIMORE.

BALTIMORE, *July 28, 1891.*

SIR: In accordance with the prevailing practice existing at this port, requiring the collector to render annually a statement of the business transactions of the port of Baltimore, for information and use in your department, I have the honor to submit the following tabulated commercial statement for the fiscal year ending June 30, 1891, as compared with the 12 months preceding, ending June 30, 1890. Barring those fluctuations which are incident to trade, the exhibit here presented possesses numerous gratifying features, showing a steady advancement in the business transacted at this port.

Tonnage movement.

	Foreign.			Coastwise.		
	1889-'90.	1890-'91.	Decrease.	1889-'90.	1890-'91.	Increase.
	Tons.	*Tons.*	*Per cent.*	*Tons.*	*Tons.*	*Per cent.*
Inward	831,917	106,755	15	1,062,810	1,382,341	29
Outward	1,124,492	905,215	19	1,218,825	1,501,158	23

Established steamship lines.

Name of steamship line.	Number of vessels.	Destination.
North German Lloyd	6	Bremen.
Allen Line	3	Liverpool.
Johnson Line	7	Do.
Do	4	London.
Blue Cross Line	(*)	Glasgow.
Do†	1	Havre.
Puritan Line	4	Antwerp.
Netherlands, American Navigation Company†	4	Rotterdam.
Neptune Line	5	Do.
Atlantic Transportation Line	8	London.
Lord Line	(*)	Glasgow.
Do	(*)	Dublin.
Hamburg-American Line	4	Hamburg.
Maryland Line†	2	Brazil.
Earn Line	(*)	Do.
Do	3	Cuba.
Sloman's Line	3	Rio.

*Occasional. †New lines, established in 1891.

Value of imports.

Value of free imports for 1891	$9,072,802
Value of free imports for 1890	5,112,678
Increase in 1891	3,960,124
Value of dutiable imports for 1891	11,482,885
Value of dutiable imports for 1890	8,027,525
Increase in 1891	3,455,360

Recapitulation of imports.

Value of free imports for 1891	$9,072,802
Value of dutiable imports for 1891	11,482,885
Total value of imports, 1891	20,555,687
Total value of imports, 1890	13,140,203
Increase in 1891	7,415,484
Imports in American vessels for 1891:	
Sailing	5,772,238
Steam	3,513
Imports in foreign vessels for 1891:	
Sailing	188,291
Steam	14,577,260
Imports in cars overland for 1891	14,385
Total	20,555,687

Value of domestic exports.

Value of domestic exports for 1891	64,349,787
Value of domestic exports for 1890	73,964,775
Decrease in 1891	9,614,988
Exports in American vessels for 1891:	
Sailing	1,592,783
Steam	113,239
Exports in foreign vessels for 1891:	
Sailing	247,141
Steam	62,396,624
Total	64,349,787

Recapitulation of exports for 1891.

Exports in American vessels	1,706,022
Exports in foreign vessels	62,643,765
Total	64,349,787

Certain articles exported.

Articles.	Tons.	Articles.	Tons.
Corn	109,729	Fresh beef	3,630
Wheat	100,553	Tallow	10,147
Flour	206,568	Lubricating oil	2,705
Cotton	39,110	Bacon	6,988
Dried apples	269	Hams	2,090
Sole leather	17	Pickled pork	4,621
Grape sugar	3,958	Lard	28,511
Rosin	17,219	Butter	43
Oil cake	26,135	Cheese	335
Lard oil	879	Clover seed	4,244
Illuminating oil	42,682	Timothy seed	1,049
Canned beef	14,687	Starch	2,068
Cotton-seed oil	659	Leaf tobacco	21,813
Copper matte	17,618	Bituminous coal	106,366
Salt beef	3,636		

Transportation in bond with appraisement.

Destination.	Values.	Duties.	Destination.	Values.	Duties.
Alexandria, Va	$75	$47.50	Philadelphia, Pa	$2,710	$2,084.40
Chicago, Ill	15,872	4,905.64	Richmond, Va	1,432	1,629.95
Cincinnati, Ohio	6,896	2,149.74	St. Paul, Minn	1,297	716.20
Georgetown, D. C	1,366	514.39	Wheeling, W. Va	842	294.70
Indianapolis, Ind	307	168.85	Milwaukee, Wis	926	274.20
Kansas City, Mo	4,185	2,491.90			
New York, N. Y	1,299	505.58	Total	37,207	15,783.05

Transportation in bond without appraisement.

Destination.	Value.	Duties.	Destination.	Value.	Duties.
Buffalo, N. Y	$382	$238.54	Memphis, Tenn	$4,046	$3,600.00
Charleston, S. C	1,687	738.30	Milwaukee, Wis	154,079	46,398.64
Chicago, Ill	1,412,101	501,849.56	Minneapolis, Minn	2.999	3,600.00
Cincinnati, Ohio	577,025	408,061.70	New York, N. Y	3,156	506.18
Cleveland, Ohio	132,771	66,129.29	Philadelphia, Pa	39,549	7,738.96
Columbus, Ohio	23,451	6.754.35	Pittsburg, Pa	169,137	51,901.74
Denver, Colo	1,636	1,800.00	Richmond, Va	2,194	864.44
Dubuque, Iowa	131	40.00	St. Joseph, Mo	818	900.00
Detroit, Mich	10,900	3,593.78	St. Louis, Mo	317,539	157,521.48
Evansville, Ind	8,272	4,264.02	St. Paul, Minn	28,072	10,177.84
Georgetown, D. C	39,283	16,198.99	Toledo, Ohio	8,091	5,615.25
Indianapolis, Ind	217,537	89,330.87	Wilmington, Del	22,035	3,231.51
Kansas City, Mo	5,016	2,110.71			
Louisville, Ky	315,861	269,076.82	Total	3,497,768	1,662,242.96

Summary of merchandise in bond without appraisement.

Year.	Values.	Duties.
1891	$3,497,768	$1,662,242.96
1890	3,036,260	1,326,344.07
Increase in 1891	461,508	335,898.89

Number of immigrants and passengers arriving.

1891	42,004
1890	28,567
Increase in 1891	13,437
Amount of duties collected in 1891	$3,689,600.96
Miscellaneous customs receipts	77,321.26
Total receipts for 1891	3,766,922.22
Total receipts for 1890	2,951,827.23
Increase, 1891	815,094.39
Duties due on merchandise in bond, 1890	132,104.20
1891	127,027.03
Decrease in 1891	5,077.17

Summary of duties, 1891.

Duties, etc., collected	$3,766,922.22
Due on merchandise in bond	127,027.03
Due on merchandise in bond with and without appraisement	1,678,026.01
Total	5,571,975.26

Vessels built.

Year.	No.	Gross tons.	Net tons.
1891	23	2,605.07	2,095.61
1890	26	4,196.11	3,197.35

Entrances and clearances.

	Tons.
Vessels entered from foreign ports—	
American:	
Sail	64,376
Steam	234
Foreign:	
Sail	14,618
Steam	627,527
	706,755
Vessels cleared for foreign ports—	
American:	
Sail	44,553
Steam	3,763
Foreign:	
Sail	11,124
Steam	845,775
	905,215
Vessels entered	706,755
Vessels cleared	905,215
Total foreign for 1891	1,611,970
Total foreign for 1890	1,956,226
Decrease in, 1891	344,256
Vessels entered coastwise, 1891	1,382,341
Vessels cleared coastwise, 1891	1,501,158
Total coastwise, 1891	2,883,499
Total coastwise, 1890	2,281,135
Increase, 1891	602,364

RECAPITULATION.

Total foreign tonnage in and out, 1891	1,611,970
Total coastwise, 1891	2,883,499
Total tonnage in 1891	4,495,469
Total tonnage in 1890	4,237,361
Increase, 1891	258,108

STATISTICAL RECAPITULATION.

Dutiable merchandise has increased	$3,455,360
Free	3,960,124
Domestic exports have decreased	9,614,988
Total tonnage of record, foreign and coastwise, increased	258,108
Increase in duties collected	$815,094.39
Decrease in duties on merchandise in bond	5,077.17
Increase in merchandise in bond, with and without appraisement	334,162.88
Decrease in the number of vessels built	3

It is necessary to add but little in the way of comment to the foregoing tabulated statement, which is suggestive in itself of the prosperity of the port. It is most gratifying to note the increase of $815,094.39 in the customs receipts over the preceding year. The renewal of the sugar industry is a source of permanently added wealth to the business of the city of Baltimore.

Experience demonstrates that the major part of American vessels engaged in the coastwise trade are not required to enter and clear at the custom-house. A recent examination into the number of vessels of three hundred tons register and upward so engaged developed the fact that there were 4,540 vessels arriving and departing from this port not required to enter and clear, aggregating 2,270,000 tons.

The foreign tonnage shows a light falling off over that of last year, owing chiefly to the scarcity of grain shipments to foreign countries. The indications for the balance of the year 1891 and the incoming year 1892 point to a large increase in that business.

The exportation of fresh beef has developed during the present year from 396 tons to 3,690 tons. There has also been a preceptible increase in the transportation of canned beef, bacon, pork, lard, illuminating oil, cotton, rosin, and bituminous coal. with a heavy decrease in corn, wheat, and flour, a falling off of almost $12,000,000 in the value of the exportation of these articles alone.

In imports there has been a marked increase throughout. More especially is the increase noticed in iron ore, tin plate, soda ash, foreign fruits, muriate of potash, coffee, rice, cement, toys, wool, and cotton cloths.

There are 17 regular lines of ocean steamers trading from this to foreign ports, representing 60 steamships, ranging in net tonnage from 1,800 to 6,000 tons each. Three new lines were established during the past year to Havre, France, Rotterdam, Holland, and Brazil in South America. Three new steamships only were added during the past 12 months to those employed by established lines.

The average draft of water of vessels in the foreign trade is 14 feet for sail vessels and 18 feet for steamers belonging to the various lines. Five such steamers, drawing over 27 feet of water, left this port during the year, passing through the channel with ease and safety. There are 1,159 vessels documented and hailing from the customs district of Baltimore, representing 102,157 net registered tons.

Respectfully submitted.

W. M. Marine, *Collector*.

Col. Wm. P. Craighill,
Corps of Engineers.

I 2.

IMPROVEMENT OF JAMES RIVER, VIRGINIA.

The improvement was regularly undertaken by the United States in 1870. A small sum had been previously expended and was of some advantage to navigation. The appropriation of 1870 was $50,000. Since that year others have been made. The last was $200,000, September 19, 1890. The total expended by the United States to July 1, 1891, has been $1,221,505.56. In addition the city of Richmond has expended nearly $500,000, but in the last 5 years only $50,000, and this near the wharves of the city.

When the improvement was undertaken by the Government navigation was obstructed by sunken vessels, by remains of military bridges, and by obstructions put in the river during the late war to prevent the national fleets from approaching too close to Richmond. There were besides natural obstructions.

Rockett's Reef and Richmond Bar had only 7 feet of water at mean low tide. From Warwick Bar (where the depth was 13 feet) to Richmond the channel was crooked and obstructed by dangerous rocks and ledges. The Dutch Gap Cut-off, which now saves 5½ miles of difficult navigation, was not then open.

The original project was to secure a depth of 18 feet at full tide, corresponding to 14.5 feet at low tide, to Richmond, with a channel width of 180 feet from Harrison Bar to Richmond Docks, the excavation in rock to be 18½ feet at full tide. This plan was well advanced when Congress, by act approved July 5, 1884, adopted the project of 22 feet at mean low tide from Richmond to the sea. Operations during the past year have been conducted in accordance therewith. In carrying it out further a large amount of excavation will be in solid rock, and the cost will necessarily be great. The width to be given to the channel is 400 feet from the sea to City Point, 300 feet from City Point to Drewry Bluff, and 200 feet from thence to Richmond. The methods employed for improving the river consist in dredging, rock excavation, and the contraction of the water way by means of dikes or jetties.

Mr. C. P. E. Burgwyn has continued the efficient resident engineer of the work. His detailed report is appended.

Decided gain has been made in the last year in the improvement of the navigation by the work done under the existing contracts, and more may be confidently expected from the expenditure of the funds still available.

Money statement.

July 1, 1890, balance unexpended		$785.87
Amount appropriated by act approved September 19, 1890		200,000.00
		200,785.87
June 30, 1891, amount expended during fiscal year		57,828.22
July 1, 1891, balance unexpended		142,957.65
July 1, 1891, outstanding liabilities	$2,000.00	
July 1, 1891, amount covered by uncompleted contracts	107,693.83	
		109,693.83
July 1, 1891, balance available		33,263.82
Amount (estimated) required for completion of existing project		3,736,070.45
Amount that can be profitably expended in fiscal year ending June 30, 1893		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging and excavating rock from the channel of James River, Virginia, and for the construction of mattress dike and jetties, opened December 9, 1890, at 12:05 p. m.

No.	Name and address of bidder.	Prices to excavate and deposit.					
		A. 27,600 cubic yards disintegrated rock, Richmond to Stearn's Dike, per cubic yard.	B. 3,750 cubic yards solid rock, Richmond to Stearn's Dike, per cubic yard.	C. 29,500 cubic yards disintegrated rock, Stearn's Dike to Goode's Rocks, per cubic yard.	D. 6,400 cubic yards solid rock, Stearn's Dike to Goode's Rocks, per cubic yard.	E. 3,200 cubic yards disintegrated rock at Goode's Rocks, per cubic yard.	F. 4,500 cubic yards solid rock at Goode's Rocks, per cubic yard.
1	Alabama Dredging and Jetty Company, Mobile, Ala	$1.35	$6.40	$1.35	$6.40	$1.35	$6.40
2	James F. Bradley, Manchester, Va						
3	L. A. Guy, Richmond, Va						
4	W. Hampton Curtis, Richmond, Va						
5	Chester T. Caler, Norfolk, Va	.45	2.25	.45	2.26		
6	James T. Vaughan, Richmond, Va	.47	2.40	.47	2.40		
7	W. S. Gunn, Richmond, Va	.40	2.00	.40	2.00		
8	American Dredging Company, Philadelphia, Pa	.40	2.00	.40	2.00	1.50	8.00
9	C. D. Langhorne, Richmond, Va	.45	1.10	.45	1.10	1.45	6.15
10	O. J. Jennings, Fulton, N. Y						8.00
11	Anson M. Bangs, Fayetteville, N. Y						
12	Baltimore Dredging Company, Baltimore, Md						

Abstract of proposals for dreding and excavating rock from the channel of James River, Virginia, etc.—Continued.

No.	Name and address of bidder.	Prices to excavate and deposit.					Construct.	
		G. 34,800 cubic yards gravel, Goode's Rocks to Randolph Flats, per cubic yard.	H. Solid rock, Goode's Rocks to Randolph Flats, per cubic yard.	I. 102,600 cubic yards coarse sand, Randolph Flats to Falling Creek, per cubic yard.	J. 48,000 cubic yards sand at Kingsland Reach, per cubic yard.	K. 85,000 cubic yards clay at Dutch Gap, per cubic yard.	L. 2,150 linear feet mattress dike, per linear foot.	M. 2,700 linear feet jetties, per linear foot.
1	Alabama Dredging and Jetty Company, Mobile, Ala		$0.40					
2	Jas. F. Bradley, Manchester, Va						$2.47	$2.84
3	L. A. Guy, Richmond, Va						2.84	3.11
4	W. Hampton Curtis, Richmond, Va						1.79	2.49
5	Chester T. Caler, Richmond, Va	$0.24½	2.26	$0.34½	$0.16½	$0.50½		
6	James T. Vaughan, Richmond, Va	.26	2.40	.36	.17	.53		
7	W. S. Gunn, Richmond, Va	.24	2.00	.34	.16	.50		
8	American Dredging Company, Philadelphia, Pa	.16	2.00	.28	.16	.50	3.00	3.00
9	C. D. Langhorne, Richmond, Va	.20	6.15	.25	.16	.30	3.00	3.00
10	O. J. Jennings, Fulton, N. Y							
11	Anson M. Bangs, Fayetteville, N. Y						2.57	3.29
12	Baltimore Dredging Company, Baltimore, Md	.24$\frac{3}{10}$		.34½	.16½			

SUMMARY BY TOTALS.

No.	Total to excavate and deposit.					
	A. Disintegrated rock, Richmond to Stearn's Dike.	B. Solid rock Richmond to Stearn's Dike.	C. Disentegrated rock, Stearn's Dike to Goode's Rock.	D. Solid rock, Stearn's Dike to Goode's Rock.	E. Disintegrated rock at Goode's Rock.	F. Solid rock at Goode's Rock.
1	$37,260	$24,000.00	$39,825	$40,960	$4,320	$28,800
2						
3						
4						
5	12,420	8,437.50	13,275	14,404		
6	12,972	9,000.00	13,865	15,360		
7	11,040	7,500.00	11,800	12,800		
8	11,040	7,500.00	11,800	12,800	4,800	36,000
9	12,420	4,125.00	13,275	7,040	4,640	27,675
10						36,000
11						
12						

No.	Total to excavate and deposit.				Construct.		Grand total.
	G. Gravel Goode's Rock to Randolph.	I. Coarse sand, Randolph to Falling Creek.	J. Sand at Kingsland.	K. Clay at Dutch Gap.	L. Mattress dike.	M. Jetty.	
1							
2					$5,310.50	$7,668	
3					6,106.00	8,397	
4					3,848.50	6,723	
5	$8,439.00	$35,397	$7,740.00	$42,925			
6	9,048.00	36,939	8,160.00	45,050			
7	8,352.00						
8	5,568.00	28,728	7,680.00	42,500	6,450.00	8,100	$182,966
9	6,960.00	25,650	7,680.00	25,500	6,450.00	8,100	149,515
10							
11					5,520.50	8,883	
12	8,421.61		35,012.25	7,920			

Contract with W. Hampton Curtis for items L and M.
Contract with C. D. Langhorne for items A, B, C, D, E, F, G, I, and J.
Bids for items H and K rejected.

Abstract of proposals for dredging in the James River, Virginia, near Richmond and at Kingsland Reach, Opened December 23, 1890, at 12:05 p. m.

No.	Name and address of bidder.	Excavate and deposit.			
		Disintegrated rock near Richmond, per cubic yard.	Solid rock near Richmond, per cubic yard.	Sand at Kingsland Reach, per cubic yard.	Total.
1	C. D. Langhorne, Richmond, Va	$0.45	$1.10	$0.16	$9,000
2	C. T. Caler, Norfolk, Va	.38	1.04	.13	7,440
3	James T. Vaughan, Richmond, Va	....	....	.16¼	....

Contract with C. T. Caler.

Abstract of proposals for dredging in the James River, Virginia, near Richmond, opened April 1, 1891, at 12:05 p. m.

No.	Name and address of bidder.	Time.		Excavate and deposit.			
		Commence.	Complete.	Sand per cubic yard.	Bowlders per cubic yard.	Logs per linear foot.	Total.
1	C. T. Caler, Norfolk, Va	When get through at Kingsland.	30 days	0.44¾	$3.00	$1.03	$2,807.50
2	James T. Vaughan, Richmond, Va.	At once	30 days	44	3.00	1.00	2,755.00

Contract with James T. Vaughan.

REPORT OF MR. C. P. E. BURGWYN, ASSISTANT ENGINEER.

ENGINEER'S OFFICE,
Richmond, Va., July 1, 1891.

COLONEL: I have the honor to submit the following report of operations connected with the improvement of the James River for the fiscal year ending June 30, 1891:

At the commencement of the year, namely, July, 1890, all field operations connected with the improvement of the river had ceased, owing to the exhaustion of the funds available.

Shortly afterward the office was closed and the office force scattered, so that when the river and harbor act became a law in September some considerable time elapsed before it was possible to begin the work again.

The operations were mainly a continuance of the work of last year and consisted in the further prosecution of the survey; in removing a bar at Richmond, created by the frequent freshets; in widening and deepening the channel from Richmond to Stearns Dike, and from Stearns Dike to Goode Rocks; in the construction of wing dams at Wilton; in the construction of a training wall, and in dredging the channel at Kingsland; and in the removal of a part of the slide at Dutch Gap.

SURVEY.

As soon as practicable a field force was organized and the work of the survey was commenced from the point where it was discontinued last year, viz, Jordan Point. The force remained in the field until the last of February, when it was discontinued for the time being and the working up of the notes was begun. The soundings were taken from Jordan Point to Hog Island, a distance of 33 miles, with the exception of a stretch of about 3 miles in the very wide water opposite the mouth of the Chickahominy River, where the high winds prevalent in the winter season of the year rendered it more difficult to operate than at some future time. Four hundred and twenty-one lines of soundings were taken, varying in length from 1,000 feet to about 3 miles. The maps resulting from this survey have all been plotted, and the sections are now being selected from which to calculate the high tide and the low tide area, the maximum and the mean depth, the position of the center of area, the width, and the tidal volume in between the sections.

FRESHETS.

The past year has been memorable on account of the number of freshets which have occurred, not individually so extremely high, but their continued frequency has been such as to interfere greatly with the execution of the contract work. Their effects upon the channels and in behind the training walls and wing dams have enabled a very complete study to be made of the action brought about by the works of contraction.

Excepting in the harbor, where a freshet invariably deposits a large quantity of sand, the action between the city and Drewry Bluff has been slight and may be described as follows: A deposit of some considerable quantity of sand has taken place in behind the training wall on the right bank from the first wing dam to a location about opposite the Chesapeake and Ohio wharves, a distance of about half a mile. In the channel between these points no deposit of any kind was observed. Between the Chesapeake and Ohio wharves and Goode Rocks some small amount of sand was deposited in the pockets which had been left in the dredging of the disintegrated rock, and some small amount of mud was thrown down opposite the mouth of Goode Creek. There was but little deposit behind the training walls, and over this section it is doubtful if as much as 2,000 cubic yards of movable material was shifted into the channel by the continuous action of all the freshets. There does not appear to be any deposit in the narrow channel through Goode Rocks. Just below Goode Rocks there appears to be a slight deposit of sand, but it was only a few hundred feet in length, and it may be scattered by the tidal action. From the lower end of Goode Rocks to Drewry Bluff no appreciable change has been detected either behind the training walls or in the river. Between Drewry Bluff and Dutch Gap, the only point where systematic observations were taken was at Kingsland. Here a training wall was in process of construction, and dredging was going on simultaneously with the occurrence of the freshets. The action upon the dredged channel was to round off the sides. This greatly improved the navigable channel, though it might technically be said to have deteriorated the dredged channel. This deterioration, if any, has not amounted to more than 2 feet in a depth of cutting of about 6 feet. Below the location of the dredged channel a scour was induced amounting to as much as 4 feet. A map made after the freshets were over showed by soundings a continuous depth of 25 feet at full tide through this much dreaded barrier, and it is believed that a vessel can be carried through drawing 23 feet. To render the channel stable the remainder of the dredging contemplated, amounting to about 48,000 cubic yards, should be done. This, it is confidently expected, will ameliorate the navigation of this reach for many years to come.

On the whole, the freshet action at Kingsland was much more beneficial than hurtful.

The construction of the training wall was carried on successfully notwithstanding the freshets. As this training wall was in some places built in water 15 feet deep, it speaks volumes for the adaptability of the style of the training wall to the necessities of the occasion, to state that an 8-foot freshet went over the dike when it was in an incomplete condition without injuring it appreciably. At and below Dutch Gap the action of the freshet has not been detected as having made any marked change of condition.

The effect of these numerous freshets has thus been fully described in order to put upon record how slight their effect now is upon the navigable condition of the river, and to observe how erroneous is the impression that the channels are continually filling up.

The following is a list of the freshets that have occurred since January, 1890, and the height to which they have risen above mean low tide at Richmond.

Date.	Height.	Remarks.
	Feet.	
February 9, 1890	9.6	
January 12, 1891	7.9	
February 10, 1891	10.4	Strong water 9th to 14th.
February 24, 1891	8.0	Strong water 23d to end of month.
March 13, 1891	14.4	Height of rise at 11 p. m.
March 24, 1891	9.7	Strong water several days.
March 30, 1891	10.4	Strong water 28th, 29th, and 30th.
April 3, 1891	14.4	Strong water several days.
April 12, 1891	11.9	Water rose from 3 a. m. to 12.
May 30, 1891	12.2	

As previously mentioned, these freshets created a bar near Richmond, which was taken out partly by the United States and partly by the city of Richmond. That taken out by the United States consisted of 4,581.4 cubic yards of sand, and was executed in April in 9½ days.

RICHMOND TO STEARN DIKE.

The work done here consisted in widening and deepening the channel, and was prosecuted under contracts with two separate parties, C. T. Caler and C. D. Langhorne. The nature of the excavation was such as to prevent the contractors from making the required depth, on account of the solid rock present. However, the depth was made over by far the larger part of it, and the success in getting down so frequently to the required depth, namely, 22 feet at low tide, without blasting at all, is one of the most encouraging features connected with this part of the river. The following is a summary of the work done:

Date.	Cubic yards.		
	Disintegrated.	Solid.	Total.
1891.			
January	3,782.3	550.1	4,332.4
February	2,679.3	101.9	2,781.2
March	2,396.6	42.9	2,439.5
April	3,724.7	2.9	3,727.6
May	6,608.3	56.4	6,664.7
June	9,327.8	125.9	9,453.7
	28,519.0	880.1	29,399.1

STEARN DIKE TO GOODE ROCKS.

This work was prosecuted very vigorously and satisfactorily by the contractor, Mr. C. D. Langhorne. This reach in the river was by far the one most dangerous to navigation. The material, as a general thing, consisted of points of solid rock in a matrix of material more or less decomposed. Where the material was not sufficiently disintegrated to be gotten up by the dredges there still remain certain points which will require drilling and blasting before the final depth can be obtained, but the large quantity of material gotten out at this low price enables enough to be saved from the original estimates to execute the necessary drilling and blasting, and still bring the completed cost within the estimated limits. The required depth, namely, 22 feet at low tide, was obtained in only a few places. In general, the depth of 17 feet at low tide was obtained, although there are some few lumps with only 14 feet over them. The following is the summary:

Date.	Cubic yards.		
	Disintegrated.	Solid.	Total.
1891.			
January	7,440.2	699.7	8,140.4
February	4,512.8	532.7	5,045.5
March	4,654.6	297.7	4,952.3
April	4,573.8	64.2	4,638.0
May	6,739.8	236.0	2,975.8
June	7,360.4	228.6	7,589.0
	35,282.1	2,058.9	37,341.0

GOODE ROCKS.

Work was begun on these rocks on the 27th of December but was almost immediately interrupted by ice. One dredge went through the old cut in the early part of January to see if there had been any lodgment of material from past years. The dredge scraped up some little gravel and a few pieces of solid rock, but after working a week and getting so little the operations at this point were temporarily stopped until the new cut should have been thoroughly drilled and blasted.

On account of the many freshets it was not until June that arrangements for this were completed. Preparation has been made, however, to prosecute this work with two drills and two platforms, and there is every indication that the contractor will push this work with the same vigor he has pushed the other. In January 32.4 cubic yards of disintegrated and 45.5 cubic yards of solid material was removed. In June nine holes were drilled, aggregrating 57 feet, and 55.7 cubic yards of material classified as disintegrated and 48.1 cubic yards of material classified as solid were removed.

WING DAM AT WILTON.

This work was carried on under a contract with W. Hampton Curtis, who experienced delay in securing material at the right time. The nature of the improvement was designed; for two purposes; first, to narrow the width of the river at this point so as to create a scour and thus sweep the sand into the deep holes below; and the second was to provide in behind the wing dams a place of deposit for a portion of the material excavated above in the future operations from Randolph Flats to Falling Creek.

The style of the wing dam is the same as that previously used on the river, and no description is needed here. They were twelve in number. While the work may not be called completed, yet it is in such a state as to have complete action; that is, all the piles are driven, most of the sheet piling, the bracing, and the capping completed, and about half of the mattress brush is in position. Quite a severe freshet came upon the work when in an incomplete condition, but with the exception of about 40 feet at the end of one of the wing dams no damage appreciable was done.

The following represents a summary of the work done:

Date.	Piles driven.	Feet of brush mattress laid.	Tons of material in weighting.	Linear feet constructed.		
				Sheet piling.	Waling.	Capping.
1891.						
April	191	....	....	302	....	....
May	98	....	....	1,152	2,498	....
June	162	1,795	586.9	739	1,066	353.5
Total	451	1,795	586.9	2,193	3,564	353.5

Work was begun after the completion of the contract at Kingsland, on the 9th of April. As far as observed it has answered its purpose well.

KINGSLAND.

The work here consisted in dredging a channel and constructing a training wall. Both works were carried on under contract; that of dredging with C. T. Caler, and that of the training wall with W. Hampton Curtis. The dredging was limited to two through cuts and a third partial cut, all made to 22 feet at low water. Dredging was begun on the 5th of February, and was pushed through to completion on the 17th of April. No special difficulty was experienced, except at one place extending down the cuts for about 800 feet, where a network of gravel mingled with large bowlders was encountered. This is probably the nucleus of the bar, and is one of the reasons of its existence. The dredges succeeded, however, in cutting through this obstruction, and the indications are that the channels thus obtained will remain with but slight deterioration.

As there is quite a current through this reach during a freshet, it might hereafter be good practice in making cuts to go several feet below the required depth, in order to allow for the unavoidable filling in while the currents are adjusting the bottom to the altered condition of things. The following is a summary of the excavation:

Date.	Sand and gravel.	Bowlders.
1891.	*Cubic yards.*	*Cubic yards.*
February	14,892.2	43.0
March	16,882.0	19.9
April	8,195.0	32.8
Total	39,969.2	95.7

As this was the shoalest point on the river, the cutting through the bar opened up a deeper draft as far as Goode Rocks, a distance of 8 miles nearer Richmond. The freshets that have passed over it since the dredging was done do not appear to have affected the cuts except as previously indicated, and it is confidently believed that this great obstruction to the navigation of the river has been permanently improved. The practical available draft through the reach is now 23 feet at high tide.

TRAINING WALL.—KINGSLAND.

The work on the construction of the training wall was begun in January by collecting materials, etc., and the actual driving of the piles commenced on the 2d of February. The work was pushed through continuously to completion on the 9th of April, notwithstanding the many freshets. The following is a summary of the work done:

Date.	Piles driven.	Cubic yards gravel used.	Cords of brush used.
1891.			
February	400	4,708.1	727.2
March	271	607.7	1,078.0
April	5		75.0
	676	5,315.8	1,880.2

Total length of training wall was 2,907.8 feet.

DUTCH GAP.

As reported in previous years the large amount of material which had formed an island in the gap by sliding forward from the main body of land was an object of solicitude, and the success of the contractor at the work last year justified the inference that the bids for executing the work would be reasonable this year, but as the lowest bid received was double that for which the work had actually been done these offers were rejected, and an agreement was later entered into with C. T. Caler to remove as much as 12,000 cubic yards at 15 cents, with the privilege of extending the amount to 85,000. He began the work promptly at the termination of his Kingsland contract, and pushed it satisfactorily until the 28th of May, when he was compelled to stop the work in order to carry out contracts elsewhere. During April he excavated 6,163.6 cubic yards, and in May 13,847.3, making a total of 20,010.9. There still remains about 65,000 cubic yards which should be removed before the work can be considered as in a satisfactory condition. As a bulkhead has been purposely left in the gap to facilitate future operations, no increase of depth or width of channel can be reported. It was eminently satisfactory to secure the excavation of such a large percentage of the material at so reasonable a cost and to discover that the excavation itself was not so difficult as had been imagined.

PRACTICAL AVAILABLE DRAFT.

Although the soundings as taken indicate a somewhat greater depth, yet such can not be taken as the practical available draft; some allowance must be made for the sagging of the line. After deducting from the indicated soundings for this purpose, the practical available draft at high water may be stated as follows: From the sea to Warwick Bar, 19½ feet; from thence to Goode Rocks, 17 feet; over Goode Rocks, 16½ feet; from Goode Rocks to Richmond (Chesapeake and Ohio Railroad Company's wharves), 18 feet.

Very respectfully, your obedient servant,

C. P. E. BURGWYN.

Col. WM. P. CRAIGHILL,
Corps of Engineers.

COMMERCIAL STATISTICS.

[Richmond, Va., custom-house report.]

Vessels, steam and sail.

Year ending—	Cleared.	Entered.	Tonnage cleared.	Tonnage entered.	Value of exports.	Value of imports.	Remarks.
June 30, 1890 …	445	469	380,172	399,563	$353,012	$58,657	The vessels varied in draft from 6 to 26 feet.
June 30, 1891 …	372	427	308,177	337,982	195,072	20,486	

	Tons.
Shipped from other points on the river exclusive of Richmond and Newport News:	
Grain	3,526
Lumber	155,307
Live cattle	644
Cord wood	182,853
Hay, shucks, etc	2,235
Miscellaneous	35,145
Total	379,710
Received at other points on the river exclusive of Richmond and Newport News:	
Coal	440
Lumber	616
Hay, shucks, etc	512
Iron	260
Miscellaneous	113,986
Total	115,814
Shipped from Newport News:	
Coal	703,851
Cotton	18,198
Grain	48,779
Lumber	19,928
Flour	41,170
Tobacco	4,209
Lard and grease	4,797
Live cattle	6,275
Miscellaneous	117,707
Total	1,054,912
Received at Newport News:	
Coffee	135
Iron	915
Salt	1,200
Miscellaneous	157,347
Total	159,597
Shipped from Richmond:	
Coal	22,000
Cotton	6,500
Grain	2,100
Flour	17,500
Tobacco	16,542
Live cattle	977
Miscellaneous	42,500
Total	108,119
Received at Richmond:	
Coal	62,500
Cotton	1,450
Grain	4,500
Lumber	5,410
Lime and cement	6,830
Cord wood	22,500
Hay, shucks, etc	500
Ice	42,000
Miscellaneous	80,819
Total	226,509

	Tons.
Totals, including Richmond and Newport News:	
Shipped—	
Coal	815,851
Cotton	24,698
Grain	54,405
Lumber	175,235
Flour	58,670
Tobacco	20,751
Lard and grease	4,797
Live cattle	7,896
Cord wood	182,853
Hay, shucks, etc	2,235
Miscellaneous	195,352
Total	1,542,741
Received—	
Coal	62,940
Cotton	1,450
Grain	4,500
Lumber	6,026
Lime and cement	6,830
Cord wood	22,500
Hay, shucks, etc	1,012
Coffee	135
Iron	1,175
Salt	1,200
Ice	42,000
Miscellaneous	261,333
Total	411,101
Totals, including Richmond and excluding Newport News:	
Shipped—	
Coal	22,000
Cotton	6,500
Grain	5,626
Lumber	155,307
Flour	17,500
Tobacco	16,542
Live cattle	1,621
Cord wood	182,853
Hay, shucks, etc	2,235
Miscellaneous	77,645
Total	487,829
Received—	
Coal	62,940
Cotton	1,450
Grain	4,500
Lumber	6,026
Lime and cement	6,830
Cord wood	22,500
Hay, shucks, etc	1,012
Iron	235
Ice	42,000
Miscellaneous	103,986
Total	251,479

NOTE.—By some it is claimed that the commerce of Newport News should be credited to the James River, and by others not. One of the tables shows the tonnage exclusive of that of Newport News, and another includes it.

I 3.

PRELIMINARY EXAMINATION OF PATAPSCO RIVER, MARYLAND, FROM THE CRAIGHILL CHANNEL TO THE SUGAR REFINERY WHARVES, CURTIS BAY.

[Printed in House Ex. Doc. No. 102, Fifty-first Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., December 13, 1890.

GENERAL: In compliance with your instructions of September 20, 1890, I have the honor to submit the report below on the preliminary examination of "Patapsco River, Maryland, from the Craighill Channel to the sugar refinery wharves, Curtis Bay:"

Curtis Bay is the lower end or mouth of a creek or estuary entering the Patapsco River on the west bank about 4 miles below the city of Baltimore. It forms a nearly circular harbor, with a natural depth of from 22 to 26 feet of water, and is admirably situated for industrial enterprises needing deep-water connections in combination with the railroad facilities centering in Baltimore City.

At this point are now located the following industries: Baltimore Sugar Refining Company, with a present paid-up capital of $1,000,000, and machinery with a capacity for turning out per day 1,500 barrels of sugar, requiring for this purpose 80,000 tons of raw sugar per annum; the South Baltimore Car Works, with an annual output of $1,250,000; the South Baltimore Foundry, with an annual output of $300,000; the Ryan and McDonald Manufacturing Company (locomotives, machinery, etc.), with an annual output of not less than $500,000.

The Baltimore and Ohio Railroad have in view the erection of large coal piers in this vicinity, where they own extensive water fronts; and it is expected in the near future to establish here an extensive plant for the manufacture of steel rails and plates.

The direct connection from the large pier of the sugar refinery to the ship channels leading to Baltimore intersects what is known as the Fort McHenry division in a distance of about 2¼ miles.

To make by dredging a channel from the main ship channel of a width of 150 feet at bottom and of a depth of 25 feet at mean low water would cost $25,000. To give the same width, but a depth of 27 feet at mean low water, which is the depth of main ship channel, would cost $85,000.

It can hardly be doubted that with deep water, a good harbor, and cheap land and rail connections with the whole country, this locality is destined in the near future to be the seat of very large manufacturing operations in addition to the notable ones heretofore named as already in existence.

In view of the facts and reasons set forth above, and of the present and prospective demands of commerce, it is my opinion that the improvement is worthy to be made by the United States.

A tracing showing the locality is herewith.* No additional survey is necessary.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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* Not reprinted.

APPENDIX J.

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF HARBOR AT BRETON BAY, MARYLAND, AND OF CERTAIN RIVERS ON WESTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Potomac River at Washington, District of Columbia.
2. Potomac River at Mount Vernon, Virginia.
3. Occoquan Creek, Virginia.
4. Aquia Creek, Virginia.
5. Harbor at Breton Bay, Maryland.
6. Nomini Creek, Virginia.
7. Patuxent River, Maryland.
8. Rappahannock River, Virginia.
9. Urbana Creek, Virginia.
10. York River, Virginia.
11. Mattaponi River, Virginia.
12. Pamunkey River, Virginia.

EXAMINATIONS.

13. St. Leonard Creek, Maryland.
14. St. Jerome Bay, Maryland.
15. Piscataway Creek, Maryland.
16. Newport Creek, head of Wicomico River, Charles County, Maryland.
17. Smith Creek, Maryland.
18. Nandua Creek, Virginia.
19. Potomac Creek, Virginia.
20. Upper Machodoc Creek, Virginia.
21. [Great] Wicomico River, Virginia.
22. Crane's Creek, Virginia.
23. Piscataway Creek, Virginia.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 10, 1891.

GENERAL: I have the honor to forward herewith my annual report for the year ending June 30, 1891, on river and harbor works in my charge.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 1.

IMPROVEMENT OF POTOMAC RIVER AT WASHINGTON, DISTRICT OF COLUMBIA.

Before the commencement of this improvement the channel to Georgetown, D. C., was narrow and crooked, and had not sufficient depth to meet the needs of commerce. Vessels drawing 16 feet often grounded at high tide above Long Bridge, and frequent dredging was necessary to maintain even this depth. The channel was narrow, as the appropriations for dredging were too small to provide for more than a narrow cut through the bar. The Washington Channel was narrow and shoal, and inadequate to the wants of commerce. Extensive mud flats existed along the city front from Observatory Hill to a point opposite the arsenal. Below Long Bridge these flats were separated from the city front by the Washington Channel. The greater portion of these flats was exposed at low tide and covered at high tide by water polluted by the sewage of the city. At the foot of Seventeenth street NW. a large sewer discharged directly upon the flats. These conditions rendered a portion of the city almost uninhabitable. The average rise and fall of tide in the Potomac River at Washington is 3 feet.

By act passed August 2, 1882, Congress adopted a project which has for its object the improvement of the navigation of the river by widening and deepening its channels; the reclamation or filling of the marshes or flats on the city front by depositing on them the material dredged from the channels; and the establishment of harbor lines beyond which no wharves or obstructions should be built. The project provides in detail for such depths of channels as will accommodate the largest vessels that can reach Arsenal Point with such depth at the wharves as will allow vessels to receive full cargoes without grounding at low water; for filling the flats above Long Bridge to a height of 3 feet above the flood line of 1877, and the middle part of the flats below Long Bridge to the same height, but sloping each way to a height of 6 feet above low tide at the margin of the fill; that in order to purify the water in the Washington Channel, which will be cut off at its upper end from the Virginia or Main Channel, a tidal reservoir or basin be established above Long Bridge, to be filled with water from the Virginia Channel on the flood tide, and discharged into the Washington Channel on the ebb.

The plan also contemplates the rebuilding of Long Bridge, with longer spans and fewer piers, during the progress of the work, and the interception of all sewage now discharged into the Washington Channel and its conveyance to James Creek; but neither the reconstruction of the bridge nor the building of the intercepting sewer were included in the estimate of the cost of the improvement.

The estimated cost of the improvement is $2,716,365.

Appropriations have been made as follows:

Act of August 2, 1882	$400,000
Act of July 5, 1884	500,000
Act of August 5, 1886	375,000
At of August 11, 1888	300,000
Act of September 19, 1890	280,000
Total	1,855,000

Twenty thousand dollars of the appropriation of September 19, 1890, was made available for dredging in the Anacostia River. About that amount will be expended at that locality, which leaves the aggregate appropriations for the Potomac proper $1,835,000.

Up to the close of the fiscal year 1890 the expenditures aggregated $1,561,705.50, and the following work had been accomplished: The Virginia Channel above Long Bridge had been deepened to 20 feet at low tide for a width of from 400 to 550 feet, a part of which has since filled up and been redredged. The same channel below Long Bridge had been dredged to a depth of 20 feet and a width of about 350 feet. This part of the Virginia Channel has maintained itself to the full depth originally dredged or has deepened. The Washington Channel had been dredged to a depth of 20 feet for a width of 350 feet throughout its entire length, and to a depth of 12 feet from the 20-foot channel nearly to the easterly margin of the fill-up as far as the Seventh Street Wharf. This channel has for the most part maintained itself, though some filling occurred during the freshet of June, 1889. All the material dredged from the river had been deposited on the flats, and of the 12,000,000 cubic yards estimated to be required about 8,301,000 had been deposited. The entire area of the flats, about 621 acres, had been outlined, the margins or embankment protected as far as practicable by riprap, and practically the entire area to be reclaimed had been raised above overflow at ordinary high tide. The outlet gates of the tidal reservoir at the head of the Washington Channel had been completed, with the exception of the coping.

During the fiscal year 1891 the expenditures have been $65,115.87.

The work done during the past year is as follows:

Immediately upon the approval of the river and harbor act of September 19, 1890, the construction of a revetment or sea wall to protect the embankments or margins of the fill, which were being considerably damaged by waves and currents, was commenced. About 5,100 linear feet of dry stone wall have been built at places most liable to erosion by waves and where the conditions would permit. The wall is built on a riprap footing. It is 6 feet high, 4 feet thick at the base by 2½ feet at the top, with vertical back and a batter on the face. The work is being done by hired labor, and stone of a size rather larger than ordinary building stone, from the Potomac quarries, is used.

The bar in the Virginia Channel above Long Bridge has been dredged several times, but each time it fills up. With a view to reducing the deposit at this locality an earthen embankment or dike on the westerly side of the channel, is projected. The embankment is thrown up by a dredge and protected by riprap deposited in front. This dike has been in progress by hired machinery and purchase of material in open market, and is now about one-half completed.

The principal dredging operations during the past year have consisted in raising the embankments on the margin of the reclaimed flats. This is work which must be done in any event, and it is important that it be done soon in order to protect the work already accomplished from damage in the event of freshets. To do this work advantageously requires dredges peculiarly fitted, and one such, hired by the hour, has been employed for some months. The work done in this way has been economically and advantageously done.

A contract dated December 17, 1890, with the Alabama Dredging and Jetty Company, is now in progress, for dredging about 500,000 cubic yards of material from the Washington Channel and depositing the material on section III of the flats (that part below Long Bridge). Under this contract the 12-foot dredging between the 20-foot channel and the easterly margin of the fill will be continued up to the head of the channel. This, when accomplished, will complete the dredging in the Washington Channel. The contractor uses ordinary clam-shell machines for dredging, and deposits the material by means of the Riker pump (described in my Annual Report for 1888) and chutes.

The act of September 19, 1890, provides that $20,000 of the appropriation of $280,000 for improving the Potomac River shall be available for expenditure on the channel in the Anacostia River between the Navy Yard and Giesboro Point. Under this provision a contract was made with Frank C. Somers, of Camden, N J., under date of June 10, 1891, to widen and deepen the channel, the width to be about 200 feet and the depth 20 at low tide. It is proposed to deposit the excavated material in embankment on the flats, with the object of controlling the currents and reducing the deposit in the channel. The contract price is 17.9 cents per cubic yard, scow measurement. The work is to be begun on or before September 1, 1891, and be completed by December 31, 1891.

During June, 1891, a contract was awarded to Frank C. Somers for dredging about 400,000 cubic yards of material from the Virginia Channel above Long Bridge, the material to be deposited on the adjacent flats. The price is 15.5 cents per cubic yard, the work to be commenced by August 15 of the present year.

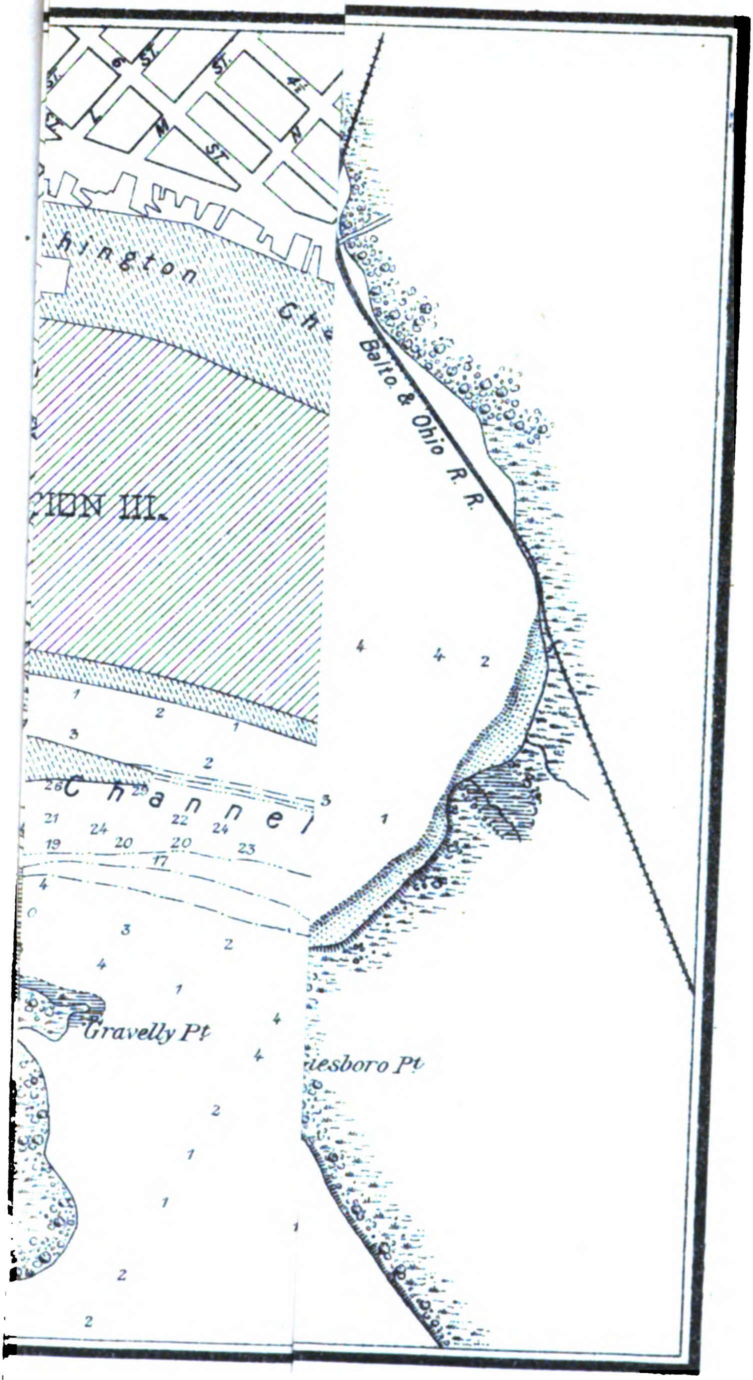
Of the 12,000,000 cubic yards estimated to be required to fill the flats to the proper level, it is estimated that 8,566,000 cubic yards have been placed on them up to the close of the fiscal year 1891.

It is unfortunate that Congress has not seen its way clear to make more liberal appropriations for this important work. What has been done has been economically done, but it would have cost less had adequate appropriation been made, so that the work could have been kept continuously going. The lack of funds has retarded the execution of the work, so that we have been overtaken by freshets before it could be made secure against damage by them. The freshet of 2 years ago, the highest of which there is any authentic record, damaged the work more than was at first supposed, yet, notwithstanding these and other drawbacks, it is believed that the work can yet be completed within the estimates if a single large appropriation be made. From a business point of view it would be an economical measure to appropriate in one sum the full amount needed to complete it.

LONG BRIDGE.

The project for the improvement of the Potomac River contemplated the removal or rebuilding of Long Bridge. As the improvement progresses, the necessity for this becomes more and more urgent. The piers of the bridge are more numerous than are necessary in a structure built according to modern plans, and are in a direction oblique to the flow of freshets. Furthermore, they are surrounded by great quantities of riprap stone which has been deposited around them from time to time to protect them. I estimate that below low-tide level the natural discharge area of the Potomac River at Long Bridge is reduced over 30 per cent. by the piers and their foundations as they exist to-day.

Long Bridge, on account of its faulty construction, remains a constant menace to the interests on the river front above it, and also to the work of improvement of the flats, upon which the Government has already spent a large sum. In the event of a freshet occurring while the river is full of ice, the most serious results are to be apprehended, and such a contingency is not at all unlikely. In such event it may be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reasonably expected that an ice gorge will form at Long Bridge, backing up the waters of the river and overflowing portions of the city front, and, through the sewers above the bridge, such of the lower parts of the city as may be drained by them.

During the freshet of June, 1889, the water reached a height at Long Bridge of about 13 feet above low tide. The street surface at Fourteenth and B streets NW. is about 8 feet above low tide, and during the freshet referred to the water was about 5 feet deep in the street at that locality. Great damage was done by the freshet of 1889, but greater damage may occur from a freshet of lesser magnitude, if accompanied by an ice gorge. The bridge should be rebuilt as recommended by the Board of Engineers.

Amount expended on the improvement up to and including June 30, 1891	$1, 626, 821. 37
Amount required to complete the improvement in addition to amount on hand	881, 365. 00
Annual cost of preserving and maintaining (estimated)	5, 000. 00

Washington City is in the collection district of Georgetown, D. C.; nearest lighthouse, Jones Point, Virginia.

Money statement.

July 1, 1890, balance unexpended		$13, 294. 50
Amount appropriated by act approved September 19, 1890		280, 000. 00
		293, 294. 50
June 30, 1891, amount expended during fiscal year		65, 115. 87
July 1, 1891, balance unexpended		228, 178. 63
July 1, 1891, outstanding liabilities	$16, 775. 44	
July 1, 1891, amount covered by uncompleted contracts	170, 620. 65	
		187, 396. 09
July 1, 1891, balance available		40, 782. 54
Amount (estimated) required for completion of existing project		881, 365. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		881, 365. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in the Potomac River, at Washington, D. C., opened November 25, 1890, by Lieut. Col. Peter C. Hains, Corps of Engineers.

TIDAL RESERVOIR—200,000 CUBIC YARDS.

No.	Bidder.	Price per cubic yard.	Amount.	Commence.	Do monthly.	Complete.
		Cents.			*Cu. yards.*	
1	Frank C. Somers, Camden, N. J	23	$46, 000	Jan. 1, 1891	....	Nov. 30, 1891
2	John H. McNee, Washington, D. C	*15	30, 000	May 1, 1891	40, 000	Dec. 31, 1892
		†16¾	33, 500	May 1, 1891	40, 000	Do.

* United States to construct embankments and waste weirs.
† Contractor to construct embankments and water weirs, as required by specifications.
*† Bottom to be found with lead line in both cases.

All bids were rejected.

Abstract of proposals for dredging in the Potomac River, at Washington, D. C., opened November 25, 1890, by Lieut. Col. Peter C. Hains, Corps of Engineers.—Continued.

WASHINGTON CHANNEL—500,000 CUBIC YARDS.

No.	Bidder.	Price per cubic yard.	Amount.	Commence.	Do monthly.	Complete.
		Cents.			*Cu. yards.*	
2	John H. McNee, Washington, D. C	*14 †15½	$70,000 77,500	May 1, 1891 May 1, 1891	40,000 40,000	Dec. 31, 1892. Do.
3	Alabama Dredging and Jetty Company, Mobile, Ala.	14½	72,500	April 1, 1891	....	6 months.

* United States to construct and maintain embankments and waste weirs.
† Contractor to construct and maintain embankments and waste weirs, as required by specifications.
*† Bottom to be found with lead line in both cases.

Contract entered into with Alabama Dredging and Jetty Company, under date of December 17, 1890.

Abstract of proposals for dredging in the Eastern Branch of the Potomac River, at Washington, D. C., opened at Washington, D. C., February 24, 1891, by Lieut. Col. Peter C. Hains, Corps of Engineers.

No.	Bidder.	Price per cubic yard.	Amount.	Commence.	Complete.
		Cents.			
1	Frank C. Somers, Camden, N. J	21	$21,000	May 1, 1891	Sept. 30, 1891
2	Baltimore Dredging Co., Baltimore, Md	18¾	18,750	Sept. 1, 1891	Jan. 1, 1892
3	Atlas Dredging Co., Wilmington, Del	21	21,000	May 1, 1891	Dec. 31, 1891
4	Thomas P. Morgan, Washington, D. C	20	20,000	June 1, 1891	Dec. 1, 1891

All bids were rejected.

Abstract of proposals for dredging in Potomac River at Washington, D. C., opened at Washington, D. C., May 27, 1891, by Lieut. Col. Peter C. Hains, Corps of Engineers.

VIRGINIA CHANNEL.

No.	Bidder.	Class A, 400,000 cubic yards.		Class B, 100,000 cubic yards.		Commence.	Complete.
		Price.	Amount.	Price.	Amount.		
		Cents.		*Cents.*			
1	John H. McNee, Washington, D. C.	16	$64,000	....	....	Aug. 1, 1891	Oct. 1, 1892
2	Frank C. Somers, Camden, N. J.	....	....	9 9/10	$9,900	Sept. 1, 1891	Dec. 15, 1891
3	Alabama Dredging and Jetty Co., Mobile, Ala	16	64,000	 11	 11,000	Nov. 1, 1891 ....do	June 30, 1892 Do.

All bids were rejected.

EASTERN BRANCH—100,000 CUBIC YARDS.

No.		Price.	Amount.	Commence.	Complete.
		Cents.			
2	Frank C. Somers, Camden, N. J	17 9/10	$17,900	Sept. 1, 1891	Dec. 31, 1891

Contract entered into with Frank C. Somers, under date of June 10, 1891.

Abstract of proposals for furnishing building stone on Potomac River improvement at Washington, D. C., opened June 1, 1891, at Washington, D. C., by Lieut. Col. Peter C. Hains, Corps of Engineers.

12,000 CUBIC YARDS.

No.	Bidder.	Price.	Amount.
1	W. H. Mohler, Washington, D. C	$1.70	$20,400

Contract entered into with W. H. Mohler, under date of June 15, 1891.

Abstract of proposals for dredging in the Potomac River, at Washington, D. C,, opened June 25, 1891, by Lieut. Col. Peter C. Hains, Corps of Engineers.

ESTIMATED QUANTITY, 400,000 CUBIC YARDS.

No.	Bidder.	Price per cubic yard.	Amount.	Commence.	Dredge monthly.	Complete.
		Cents.			*Cubic yards.*	
1	Frank C. Somers, Camden, N. J.	15½	$62,000	Aug. 15, 1891	40,000	July 31. 1892
2	Alabama Dredging and Jetty Company, Mobile, Ala.	17	68,000	Nov. 1, 1891	40,000	Nov. 30, 1892

Contract awarded Frank C. Somers.

Abstract of contracts for improving Potomac River in the vicinity of Washington, D. C., in force during the fiscal year ending June 30, 1891.

No.	Contractor.	Date of contract.	Subject of contract.	Price.
*1	Frank C. Somers, Camden, N. J	Jan. 21, 1890	Dredging	20 cents per cubic yard.
2	Alabama Dredging and Jetty Company, Mobile, Ala.	Dec. 17, 1890	....do	14½ cents per cubic yard.
3	Frank C. Somers, Camden, N. J	June 10, 1891	....do	17.9 cents per cubic yard.
4	W. H. Mohler, Washington, D. C	June 15, 1891	Building stone	$1.70 per cubic yard.
5	Frank C. Somers, Camden, N. J	July 7, 1891	Dredging	15½ cents per cubic yard.

*Completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Calendar year.	Coal.	Ice.	Lumber.	Sand.	Wood.	Miscellaneous.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1887	264,947	120,237	37,044	50,000	52,419	94,325	618,972
1888	240,836	108,421	45,101	50,000	33,040	104,177	581,575
1889	*92,511	115,506	41,407	75,000	35,351	128,905	488,680
1890	72,089	135,552	69,604	75,000	48,457	118,994	519,696

*The falling off in coal is due to the destruction of the Chesapeake and Ohio Canal.

Number of vessels of various classes arriving and departing.

Calendar year.	Steamers drawing from 5 to 15 feet—100 to 400 tons.	Vessels drawing from 10 to 20 feet—300 to 1,700 tons.	Vessels drawing from 4 to 10 feet—30 to 300 tons.	Barges drawing from 4 to 10 feet—100 to 300 tons.
1887	970	573	2,149	993
1888	710	525	1,588	2,821
1889	675	455	1,563	929
1890	696	491	1,572	286

Ferry and local passenger steamers are not included in the above.
No new lines of transportation were established during 1890.

J 2.

IMPROVEMENT OF POTOMAC RIVER AT MOUNT VERNON, VIRGINIA.

ORIGINAL CONDITION.

Mount Vernon is situated on the Virginia shore of the Potomac River, 14½ miles below Washington, D. C. The only convenient means of access for visitors is by the steamer which runs between Washington and Mount Vernon, landing at the wharf on the Mount Vernon estate. Between this wharf and the navigation channel of the Potomac River, a distance of about 1,900 feet, are flats on which the depth was originally but 4 feet at low tide. Great difficulty was often experienced, in consequence, in making landings even with the light-draft steamer formerly in use, and during low tides, caused by northwest winds, passengers were frequently obliged to land in boats.

PLAN OF IMPROVEMENT.

The original project provided for the dredging of a channel 150 feet wide, and from 6 to 7 feet deep at low tide, between the main channel of the Potomac River and the Mount Vernon wharf, with a turning basin at the wharf, having a radius of 150 feet. The estimated cost of this work was $14,000. In 1888, the project was amended so as to provide for a channel 200 feet wide and from 9 to 10 feet deep, with a turning basin of 200 feet radius. The revised estimate for the total cost of the amended project was $26,000.

WORK DONE AND RESULTS OBTAINED.

Under appropriations of March 3, 1879, amounting to $4,000, June 14, 1880, amounting to $3,000, and March 3, 1881, amounting to $1,500, a channel 145 feet wide and from 7 to 9 feet deep was dredged through the flats. Work under the last-named appropriation was closed September 15, 1882. Operations were then suspended for want of funds until August 11, 1888, when $6,000 were appropriated. In the mean time the channel had filled in considerably. The appropriation of August 11, 1888, was applied to deepening a part of the existing channel to a depth of from 9 to 12 feet, and to the enlargement of the turning basin to a width of 360 feet. On July 10, 1890, this work, which had been in charge of Mr. S. T. Abert, U. S. agent, was transferred to my charge.

The river and harbor act approved September 19, 1890, appropriated $2,500 to *complete* the work, and subsequent operations have been conducted with this end in view.

Proposals for dredging were invited and the following bids received February 21, 1891.

The Baltimore Dredging Company, Baltimore, Md., at 12.75 cents	$1,912.50
Atlas Dredging Company, Wilmington, Del., at 12.5 cents	1,875.00
Chester T. Caler, Norfolk, Va., at 13.75 cents	2,062.50
Frank C. Somers, Camden, N. J., at 11.5 cents	1,725.00

The contract was awarded to Frank C. Somers, of Camden, N. J., at 11.5 cents per cubic yard, and entered into March 10, 1891. Work under the contract was commenced March 28, 1891, and completed May 19, 1891. The dredging consisted in widening the channel on the westerly side, and in enlarging the turning basin, the depth made being 8 feet at low tide. Upon the completion of the work the channel was 155 feet wide, and the depth from 8 to 10 feet at low tide. The turning basin had a radius of 180 feet, with a like depth of from 8 to 10 feet. The amount of dredging was 12,846 cubic yards, which was removed in scows.

FUTURE OPERATIONS.

The channel has now sufficient dimensions for navigation, and no further work is recommended.

APPROPRIATIONS.

The following appropriations have been made:

March 3, 1879	$4,000
June 14, 1880	3,000
March 3, 1881	1,500
August 11, 1888	6,000
September 19, 1890	2,500
	17,000

Money statement.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	1,997.14
July 1, 1891, balance unexpended	502.86
July 1, 1891, outstanding liabilities	502.86

COMMERCIAL STATISTICS.

The traffic is almost entirely a passenger one, the freighting being only the incidental local trade. The improvement has permitted the use of a larger steamboat, which carried to Mount Vernon, during the calendar year 1890, about 35,000 people.

J 3.

IMPROVEMENT OF OCCOQUAN CREEK, VIRGINIA.

ORIGINAL CONDITION.

Occoquan Creek is a tributary of the Potomac River which it enters about 25 miles below Washington, D. C. The stream is navigable from its mouth at Sandy Point to the town of Occoquan, a distance of 4 miles.

Navigation was obstructed by four bars which were improved between 1873 and 1880 by dredging and dike construction, so as to secure a navigable depth of about 6 feet at low tide. Four appropriations were made from 1873 to 1878, amounting to $25,000, and in 1880 the improvement was regarded as completed.

In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey of the creek was made in 1889 by Mr. S. T. Abert, United States agent. The condition of the several bars at that date was as follows:

Lower Mud, about 3.5 miles below Occoquan. This bar had a least depth of about 3 feet and a length of about 4,000 feet. The former dredged channel was found to have filled in.

Upper Mud, about 2.25 miles below Occoquan. This bar is about 2,000 feet long. The channel dredged in 1874–'75 was found to have maintained its original dimensions, the width being about 50 feet and the depth from 5 to 6 feet.

Sand Bar, about half a mile below Occoquan. The channel formerly dredged here had filled in, the least depth being 4.2 feet.

Occoquan Bar, a sand bar opposite Occoquan. This is a short bar, with a least depth of 4 feet, the dredged channel having filled in.

PLAN OF IMPROVEMENT.

The depth desired for navigation was 6 feet at low tide. Mr. Abert proposed in his report upon the survey to secure this depth by dredging channels 8 feet deep and from 100 to 150 feet wide, and by the construction of dikes at an estimated cost of $91,250. (Report of Chief of Engineers, 1890, pages 1089–1096). On September 19, 1890, an appropriation of $10,000 was made for the new improvement, for which the following project was approved December 5, 1890.

Lower Mud.—A channel 6 feet deep to be dredged, the "upper section" for about 2,500 feet below Taylor's Point, to be 100 feet wide, the material to be deposited on the west side of the channel, and the remainder of channel or "lower section" to be 150 feet wide, the material to be removed in scows.

Upper Mud.—A channel 100 feet wide and 6 feet deep to be dredged, the material to be deposited on the east side of the channel, and the embankment so formed connected with the left bank by a dike.

Sand Bar.—A channel 100 feet wide and 6 feet deep to be dredged, and sheet-pile dikes constructed to maintain the dredged channel.

Occoquan Bar.—A channel 100 feet wide and 6 feet deep to be dredged, and a sheet-pile dike constructed to maintain the depth.

The estimated cost of this project was $45,000.

WORK DONE AND RESULTS OBTAINED.

Bids were invited for dredging at the Lower Mud, under the appropriation of $10,000, made September 19, 1890, and the following received February 21, 1891:

	In scows.	In place.	Amount.
	Cents.	*Cents.*	
Baltimore Dredging Company, Baltimore, Md	18.1	18.1	$8,326
Chester T. Caler, Norfolk, Va	19.5	22.0	9,895
D. McConville, Washington, D. C	14.5	10.5	5,190
Frank C. Somers, Camden, N. J	18.0	18.0	8,280

The contract was awarded to D. McConville, Washington, D. C., at the following prices:

Upper section.—Material dredged and deposited on the sides of the channel, 10.5 cents per cubic yard, measured in place.

Lower section.—Material dredged and removed in scows, 14.5 cents per cubic yard, measured in scows.

The contract was entered into March 23, 1891. Dredging was commenced May 8, 1891, and was in progress at the close of the fiscal year, June 30, 1891. The channel to be dredged through this bar under the present contract will be 6 feet deep and about 100 feet wide. On June 30, 1891, the upper section had been dredged to the depth of 6 feet for a width of 62 feet and a total length of 3,700 feet.

FUTURE OPERATIONS.

The work remaining to be done under the project is the improvement of the Upper Mud, the Sand Bar, and the Occoquan Bar, the estimated cost being $35,000.

APPROPRIATION.

The following appropriation has been made for the new project:

September 19, 1890	$10,000

COMMERCIAL STATISTICS.

Efforts were made to obtain commercial statistics, but the reports received were so inaccurate and misleading that they could not be used.

Occoquan Creek is in the collection district of Alexandria, which is also the nearest port of entry. The nearest light-house is at Fort Washington, Md.

Money statement.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		1,605.01
July 1, 1891, balance unexpended		8,394.99
July 1, 1891, outstanding liabilities	$150.00	
July 1, 1891, amount covered by uncompleted contracts	4,345.36	
		4,495.36
July 1, 1891, balance available		3,899.63
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

J 4.

IMPROVEMENT OF AQUIA CREEK, VIRGINIA.

ORIGINAL CONDITION.

Aquia Creek is a tributary of the Potomac River, which it enters 41 miles below Washington, D. C. The stream is navigable to Wharton Landing, about 7½ miles above the mouth. The upper part of the creek has a well-defined channel, with a width of from 60 to 200 feet, while the depth was originally from 2 to 17 feet. At a point called the Narrows, about 4½ miles above the mouth, the stream suddenly expands into a wide bay from 1,000 to 6,000 feet wide, forming a continuous shoal, on which the depth ranged generally from 2 to 4 feet, increasing near the mouth to about 7 feet. About 3 miles above the mouth the creek is crossed by a trestle bridge of the Richmond, Fredericksburg and Potomac Railroad. The bridge is provided with a draw 28 feet wide.

Between 1872 and 1878 $10,000 was appropriated by Congress and expended in dredging a channel through shoal portions of the creek, between Davis Point (about one-third of a mile below the railroad bridge) and Wharton Landing, the channel being from 40 to 50 feet wide and from 4 to 5 feet deep at low tide.

A new survey of the creek was authorized by the river and harbor act of August 11, 1888, and made in 1889, under the direction of Mr. S. T. Abert, U. S. agent. The channel formerly dredged was found to be about 40 feet wide and from 4 to 5 feet deep between the railroad bridge and the Narrows. Below the railroad bridge and in the upper part of the creek near Wharton Landing, it had filled in. Dent Landing, about three-quarters of a mile below Wharton Landing, was regarded as the highest point to which navigation could be maintained, except at great expense. The obstructions to navigation below Dent Landing were the long shoal of soft mud between the mouth and the Narrows, on which the depth ranged from 2 to 4 feet, a short bar at the mouth of Austen Creek with a ruling depth of 4 feet, and a wreck at Coal Landing.

PLAN OF IMPROVEMENT.

In the report on the survey (Report of Chief of Engineers, 1890, pages 1096–1103), Mr. Abert proposed a channel 150 feet wide and 8 feet deep between the mouth and the Narrows, and a channel 80 feet wide and 8 feet deep through the bar at the mouth of Austen Creek. He proposed to deposit the dredged material in banks on each side of the channel, the clear space between the banks below the railroad bridge to be from 1,100 feet to 1,500 feet. The estimated cost of this plan of improvement was $101,278.

On September 19, 1890, Congress appropriated $10,000 for this work, which was assigned to my charge. Upon examination of this creek, neither the character of its navigation nor the amount of its trade seemed to warrant so large an expenditure as was proposed in Mr. Abert's report. Six-foot navigation was regarded as sufficient to give all the relief needed to navigation at the present time, leaving the subject of greater depth for future action, if trade were developed by this improvement. The deposit of material near the cut was regarded as unobjectionable for the greater part of the distance between the railroad bridge and the Narrows, but below the railroad bridge embankments formed as proposed would be obstructions to sailing vessels.

The following project for the work was approved December 4, 1890: A channel 80 feet wide and 6 feet deep to be dredged between the mouth and the Narrows, at an estimated cost of $40,000, the material dredged below the railroad bridge to be removed in scows, and that above the bridge for the most part to be deposited on the sides of the channel. The proposed work above the Narrows was omitted.

WORK DONE AND RESULTS OBTAINED.

Proposals for dredging under the appropriation of $10,000 made September 19, 1890, were invited by public advertisement under date of January 20, 1891. The work offered was the dredging of the channel between Davis Point and the Narrows, a part of the dredgings to be deposited on the side of the channel and a part to be removed in scows. The following bids were received February 21, 1891:

Bidder.	Price per cubic yard.		Amount.
	In place.	In scows.	
	Cents.	*Cents.*	
Baltimore Dredging Company, Baltimore, Md	19	19	$8,930
Frank C. Somers, Camden, N. J	18	18	8,460

The prices were regarded as too high, and all of the bids were rejected. The high prices seemed to be due in part to the narrow draw, which would prevent the passage of any but the smallest class of dredges. The dredging below the bridge was then offered for contract, the material to be removed in scows and deposited in the Potomac River about 3½ miles from the place of dredging. The following bids were received May 20, 1891:

Frank C. Somers, Camden, N. J., 12½ cents per cu. yd	$6,250
Thomas P. Morgan, Washington, D. C., 20 cents per cu. yd	10,000

The contract was awarded to Frank C. Somers, of Camden, N. J., and entered into May 28, 1891. Work was commenced June 11, 1891, at the 6-foot curve near Thorny Point, and at the close of the fiscal year ending June 30, 1891, was still in progress. At that date the channel had been dredged to the full width of 80 feet for a length of about 2,670 feet, the depth being 6 feet at low tide.

FUTURE OPERATIONS.

The funds now available will complete the proposed channel through the shoaler parts of the creek below the railroad bridge. The future work proposed is the completion of the channel between the mouth of the creek and the Narrows, the estimated cost being $30,000.

APPROPRIATIONS.

The following appropriation has been made for the new work:

September 19, 1890	$10,000

COMMERCIAL STATISTICS.

Efforts were made to obtain commercial statistics, but the reports received were so inaccurate and misleading that they could not be used.

Aquia Creek is in the collection district of Alexandria, which is the nearest port of entry. Nearest light-house, Cedar Point, Md.

Money statement.

Amount appropriated by act approved September 19, 1890		$10,000
June 30, 1891, amount expended during fiscal year		500
July 1, 1891, balance unexpended		9,500
July 1, 1891, outstanding liabilities	$150	
July 1, 1891, amount covered by uncompleted contracts	6,250	
		6,400
July 1, 1891, balance available		3,100
Amount (estimated) required for completion of existing project		30,000
Amount that can be profitably expended in fiscal year ending June 30, 1893		15,000

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

J 5.

IMPROVEMENT OF HARBOR AT BRETON BAY, MARYLAND.

ORIGINAL CONDITION.

Breton Bay is a tidal estuary of the Potomac River, which it enters 82 miles below Washington, D. C. The bay is about 6 miles long, and well landlocked. Fifteen feet of water can be carried up the bay for a distance of 4 miles, and 9 feet for a distance of 5 miles. In 1874 the navigation was obstructed by a shoal at the head of the bay, extending from the 9-foot curve to the Leonardtown Wharf, a distance of about 1 mile, the least depth on the shoal being 5 feet at low tide. The material composing the shoal was soft mud.

PLAN OF IMPROVEMENT.

The original project, adopted in 1878, provided for dredging a channel 150 feet wide and 9 feet deep from the 9-foot curve in Breton Bay to the Leonardtown Wharf, with a turning basin for steamboats at the wharf 400 feet wide and 600 feet long, at an estimated cost of $30,000. In 1885 the project was amended so as to provide for a channel 200 feet wide and 10 feet deep, the turning basin to be 800 feet long and 400 feet wide. The estimated total cost of the amended project was $49,000.

In 1890 the original project was resumed, a width of 150 feet and depth of 9 feet being deemed sufficient to furnish all the facilities needed by navigation at the present time.

WORK DONE AND RESULTS OBTAINED.

From June 18, 1878, to August 11, 1888, eight appropriations were made, ranging from $3,000 to $6,500, and aggregating $32,500. This sum was applied to dredging 185,429 cubic yards of material at rates ranging from 10 to 18 cents per cubic yard. On March 2, 1889, when work was closed under the appropriation of August 11, 1888, the basin at the upper end of the channel was 645 feet long and 370 feet wide. From the lower end of the basin the channel was 150 feet wide for a distance of 1,870 feet, and for a further distance of 1,380 feet around the turn at Buzzard Point the width varied from 185 to 280 feet. The depths varied from 8.5 to 14.6 feet. No dredging had been done between the lower end of the turn at Buzzard Point and the 9-foot curve in the bay.

On July 10, 1890, the work was transferred to my charge by Mr. S. T. Abert, United States agent. The river and harbor act approved September 19, 1890, appropriated $5,000 for this work. This sum will be sufficient to complete the work called for by the original project, and will be expended with that object in view.

Bids for dredging were invited, and the following received February 21, 1891:

Baltimore Dredging Company, Baltimore, Md., at 12.5 cents per cu. yd	$3,000
Chester T. Caler, Norfolk, Va., at 15 cents per cu. yd	3,600
George C. Fobes & Co., Baltimore, Md., at 14 cents per cu. yd	3,360
Frank C. Somers, Camden, N. J., at 13.5 cents per cu. yd	3,240

The contract was awarded to the Baltimore Dredging Company, of Baltimore, Md., at 12.5 cents per cubic yard, and entered into March 9, 1891. Dredging was commenced June 15, 1891, and at the close of the fiscal year was still in progress. Under this contract the channel will be dredged 150 feet wide and 9 feet deep from the 9-foot curve in Breton Bay to the turn at Buzzard Point; all lumps will be removed. If the available amount of dredging will permit the channel will be further widened at the turn to facilitate the passage of steamers.

FUTURE OPERATIONS.

The existing project will be completed with the funds now available, and will afford all the facilities which the navigation requires at the present time. Should the trade increase in the future the question of increased dimensions of channel will be worthy of consideration, but at present no further appropriations are recommended.

APPROPRIATIONS.

The following appropriations have been made:

June 18, 1878	$5,000
March 3, 1879	4,000
June 14, 1880	3,000
March 3, 1881	3,000
August 2, 1882	5,000
July 5, 1884	3,000
August 5, 1886	6,500
August 11, 1888	3,000
September 19, 1890	5,000
	37,500

The work is in the collection district of Annapolis; nearest light-house, Blackiston Island.

COMMERCIAL STATISTICS.

No reliable statistics for the year 1890 could be obtained.

Money statement.

Amount appropriated by act approved September 19, 1890		$5,000.00
June 30, 1891, amount expended during fiscal year		517.79
July 1, 1891, balance unexpended		4,482.21
July 1, 1891, outstanding liabilities	$200.00	
July 1, 1891, amount covered by uncompleted contracts	3,000.00	
		3,200.00
July 1, 1891, balance available		1,282.21

J 6.

IMPROVEMENT OF NOMINI CREEK, VIRGINIA.

ORIGINAL CONDITION.

Nomini Creek is an important tributary of the Potomac River, which it enters about 82 miles below Washington, D. C. At the date of the survey preliminary to the inception of the improvement (1872), its navigation was obstructed by a bar of oyster shells and sand at its mouth, over which but 3 feet could be carried at low tide. The dangers and difficulties of passing the bar were still further increased by strong cross tidal currents just inside the mouth at White Point. After passing the bar a wide and navigable stream is found in which 8 feet can be carried for about 4 miles to Nomini Ferry, while 5 feet can be carried for about 6 miles above the mouth.

PLAN OF IMPROVEMENT.

The original project adopted in 1873 provided for dredging a channel through the bar 100 feet wide and 9 feet deep at low tide, with side sloped of 2 to 1, at an estimated cost of $20,000. The project was amended in 1879 by increasing the width to 150 feet in order to meet the demands of increased trade. In 1885 the project was again modified so as to provide for a channel 200 feet wide and 9 feet deep, and also for dredging a training channel and the construction of training dikes. The total cost of this amended project was placed at $62,500. In 1888 this estimate was increased to $72,500, the channel having deteriorated during the suspension of work from 1883 to 1889. Owing to the position of the channel, exposed to north and northwest winds and to cross tidal currents, it is difficult to secure any permanent or satisfactory results. The deterioration of the channel outside White Point is believed to be largely due to material stirred up by northwest winds and carried into the channel by the ebb and flood currents of Currioman Bay. In order to maintain the channel and prevent this injurious action, the project was modified in 1890 as follows: (1) The dredged channel to be 9 feet deep and 150 feet wide, this width being deemed sufficient for navigation and more likely to hold its depth. (2) Two jetties to be constructed, one from White Point on the east and one from Cedar Island on the west of the dredged channel, to extend out into Nomini Bay, parallel to the channel. (3) Dikes to be built inside White Point to check the cross currents, but the training channel to be omitted. It is estimated that this modified project can be completed at a total cost of $72,500, which was the amount of the revised estimate of 1888 for a 200-foot channel.

WORK DONE AND RESULTS OBTAINED.

From March 3, 1873, to August 2, 1882, seven appropriations were made ranging from $2,000 to $10,000, and aggregating $32,500. These appropriations were applied to dredging a channel through the bar, which at the close of work in 1883 was 100 feet wide, 9 feet deep, and 4,400 feet long. Operations were then suspended until 1889, when an appropriation of $5,000 made August 11, 1888, was expended in widening and deepening the channel outside White Point, which had partly filled in during the cessation of work. The river and harbor act of September 19, 1890, appropriated $5,000 for continuing the improvement. Bids for dredging in accordance with the modified project of 1890 were received February 21, 1891, as follows:

Baltimore Dredging Company, Baltimore, Md., at 30 cents per cu. yd....	$3,300.00
Fred. L. Somers, Washington, D. C., at 26.5 cents per cu. yd............	2,915.00
Chester T. Caler, Norfolk, Va., at 27.25 cents per cu. yd.................	2,997.50

The contract was awarded to Fred. L. Somers, of Washington, D. C., at 26.5 cents per cubic yard and entered into March 10, 1891. Dredging was commenced April 30, 1891, and completed June 19, 1891.

Ten thousand nine hundred and twenty-seven cubic yards of material were removed from the channel at and outside of White Point, the depth made being 9 feet at low tide and the width 150 feet outside of White Point and 130 feet directly at White Point. The dredged material was removed in scows, and deposited in Nomini Bay near Kingcopsico Point. The dike across the channel to Bushfield Bay inside White Point was built of riprap stone, 406 cubic yards having been purchased for this purpose.

FUTURE OPERATIONS.

The work remaining to be done for the completion of the project is the construction of the jetties, and the continuation of the dredging to 150 feet width through the remainder of the bar. In order that the work may be done within the estimates, it is essential that the appropriations should be large enough to complete the jetties at one time. This will require $20,000. The total amount needed to complete the work is $30,000, and this can be profitably expended in 1 year.

APPROPRIATIONS.

The following appropriations have been made:

May 3, 1873	$10,000
June 23, 1874	6,000
March 3, 1875	5,000
March 5, 1879	2,500
June 14, 1880	5,000
March 3, 1881	2,000
August 2, 1882	2,000
August 11, 1888	5,000
September 19, 1890	5,000
	42,500

Money statement.

July 1, 1890, balance unexpended		$513.39
Amount appropriated by act approved September 19, 1890		5,000.00
		5,513.39
June 30, 1891, amount expended during fiscal year		2,961.28
July 1, 1891, balance unexpended		2,552.11
July 1, 1891, outstanding liabilities	$150.00	
July 1, 1891, amount covered by uncompleted contracts	1,768.05	
		1,918.05
July 1, 1891, balance available		634.06
Amount (estimated) required for completion of existing project		30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

	Tons.
Tonnage for calendar year, 1889	13,542
1890	15,825

No new lines of transportation have been established, but it is reported that freight rates have been reduced one-half since the work was commenced. The improvement, when completed, will permit the use of larger vessels.

J 7.

IMPROVEMENT OF PATUXENT RIVER, MARYLAND.

ORIGINAL CONDITION.

The Patuxent River is navigable from its mouth at Drum Point, on Chesapeake Bay, for a distance of about 46 miles, as far as Bristol, Md. Vessels drawing from 10 to 12 feet can reach Holland Wharf, about 28 miles above the mouth, and a steamer drawing 8.5 feet when fully loaded, runs up to Bristol.

Prior to the commencement of the improvement, the navigation of the upper part of the river was obstructed by 2 bars, (1) Swann Point Bar, about 43 miles above the mouth, with a ruling depth of 7.8 feet, and (2) Bristol Bar at Bristol, with a least depth off the steamboat wharf of 7.6 feet, and 4.2 off the county wharf. Two other bars below, viz, Pope Shoal, about 24 miles above the mouth, and Warren Reach Bar, about 34 miles above the mouth, were mentioned in the report of the preliminary examination as worthy of survey, but they appear to offer no obstruction to the present standard of navigation.

PLAN OF IMPROVEMENT.

The original project proposed a cut 200 feet wide, and from 12 to 13 feet deep, through these bars, so as to give a completed channel about 100 feet wide, and 12 feet deep at low tide, at an estimated cost of $80,000. Under this project a channel 120 feet wide and 12 feet deep was dredged at Bristol Bar. Upon examination of the river in 1890 it appeared that a channel, about 100 feet wide and 9 feet deep, at Swann Point Bar, would afford all the facilities that the existing or immediately prospective demands of commerce would require. The steamer navigating the upper part of the river draws, as stated, but 8.5 feet when fully loaded, but is, as a matter of fact, never fully loaded when passing this bar. So far as could be learned, few sailing vessels go as high up as Bristol, and none drawing as much as 9 feet. The project was therefore modified so as to provide, in addition to the channel already dredged at Bristol Bar, a channel at Swann Point Bar, about 100 feet wide and 9 feet deep, to be supplemented by works of contraction, if these should afterward be found necessary.

WORK DONE AND RESULTS OBTAINED.

The first appropriation was made August 11, 1888, amounting to $5,000, which was applied to dredging by contract at Bristol Bar. A channel 12 feet deep, 120 feet wide, and 794 feet long, was dredged from the 12-foot curve at the lower end of the bar to a point about 250 feet above the steamboat wharf. The amount of dredging was 18,295 cubic yards, and the channel was completed January 2, 1890.

On July 10, 1890, this work was transferred to my charge by Mr. S. T. Abert, U. S. agent. In the river and harbor act of September 19, 1890, an appropriation of $6,000, was made for this improvement. Proposals were invited for dredging at Swann Point Bar, under the amended project, and the following received February 21, 1891:

The Baltimore Dredging Company, at 19.75 cents per cu. yd	$3,950
Chester T. Caler, Norfolk, Va., at 23.5 cents per cu. yd	4,700
Frank C. Somers, Camden, N. J., at 20 cents per cu. yd	4,000

The contract was awarded to the Baltimore Dredging Company at 19.75 cents per cubic yard, and entered into March 9, 1891.

Dredging at Swann Point Bar was commenced April 9, 1891, with one dipper dredge, and completed June 4, 1891. A channel 9 feet deep and 132 feet wide was dredged through the bar. This width of cutting will give a bottom width of fully 100 feet, when the sides of the channel have assumed their natural slope. The total amount of dredging was 19,525.7 cubic yards, which was removed in scows. The dredged channel is about 2,250 feet long.

FUTURE OPERATIONS.

The work already done on this river is sufficient for its present trade and navigation. It is possible that works of contraction may be required to maintain the channel at Swann Point Bar, but this question can only be determined by surveys to be made in the future. If the trade of the river should increase so as to demand deeper draft steamers and vessels, a plan of improvement corresponding to these demands will be proposed, but at the present time no further appropriations are recommended.

APPROPRIATIONS.

The following appropriations have been made:

August 11, 1888	$5,000
September 19, 1890	6,000
	11,000

The work is in the collection district of Annapolis. Nearest light-house, Drum Point, Md.

Money statement.

July 1, 1890, balance unexpended	$1.50
Amount appropriated by act approved September 19, 1890	6,000.00
	6,001.50
July 30, 1891, amount expended during fiscal year	4,816.66
July 1, 1891, balance unexpended	1,184.84
July 1, 1891, outstanding liabilities	150.00
July 1, 1891, balance available	1,034.84

COMMERCIAL STATISTICS.

The entire trade of 1889 was reported as 33,720 tons.

One line of steamers trades in the Patuxent River, and during the calendar year 1890 is reported as having carried 16,982 tons. From 25 to 50 sailing vessels are said to be engaged in transporting lumber, ties, wood, oysters, grain, and merchandise, but the quantity so carried could not be estimated.

The business on the river is reported as being unusually small during 1890, owing to the total failure of the peach crop and the partial failure of the tobacco crop, these being the most important productions of that section of country.

J 8.

IMPROVEMENT OF RAPPAHANNOCK RIVER, VIRGINIA.

DESCRIPTION.

The Rappahannock River is navigable from its mouth in Chesapeake Bay to Fredericksburg, Va., a distance of 106 miles. The lower part of the river has the character of a tidal estuary, the width varying from 1 to 3½ miles. The ruling depth at the mouth is 5 fathoms, and this depth holds to Jones Point, 28 miles above, while 17 feet can be carried to within 1 mile of Tappahannock, which is 41 miles from the mouth. Above Tappahannock the river has a tortuous course, and above Port Royal, 29 miles from Fredericksburg, it flows between high banks. The width at Fredericksburg is about 350 feet, gradually increasing to about 1,500 feet at Port Royal. In 1871, prior to the inception of the improvement, 6 feet could be carried within a mile of Fredericksburg, and then 4 feet to the town.

The Rappahannock River drains a large area of agricultural country, and is subject to freshets. The highest known freshet occurred in June, 1889, when the river rose to 32.8 feet above low tide at Fredericksburg. The freshet slope falls below Fredericksburg as the river widens. Freshets are but little felt at Port Royal and not at all at Tappahannock. They bring down large quantities of sediment, and are the chief factors in bar formation. Tides range from 2.5 feet at the mouth to 3.4 feet at Fredericksburg.

ORIGINAL CONDITION.

The obstructions to navigation lie between Tappahannock and Fredericksburg, 65 miles. The original condition of the bars was as follows:

Naylor Hole, 44 miles above the mouth. A detailed survey of the bar made in 1885, shows the least depth to be 10.7 feet. The length of the bar between the 15-foot curves is 11,000 feet. Borings show sand, mud, and gravel.

Nanzatico Reach, 72 miles above the mouth, and 4 miles below Port Royal. The ruling depth on the bar is 10.1 feet (survey of 1885), although in the track which can be conveniently followed by steamers the depth is 8.3 feet. The length of the bar between the 15-foot curves is 5,540 feet. The bar is composed for the most part of soft mud.

Farleyvale Bar, 94 miles above the mouth, and 12 miles below Fredericksburg. In 1881, before improvement, 9 feet could be carried over this bar, although the depth on the best course was 8.3 feet. The bar was composed of sand, mud, and gravel, and was about 200 feet long between the 10-foot curves.

Castle Ferry Bar, 98 miles above the mouth and 8 miles below Fredericksburg. The least depth in 1876, before improvement, was 8.4 feet, and the length between the 10-foot curves 1,400 feet. The bar is composed of sand and mud.

Spottswood Bar, 102 miles above the mouth, 4 miles below Fredericksburg. In 1871 this bar was 5,400 feet long, with a least depth of 6 feet at the "cross over," where there were 3 wrecks sunk during the late war. Before improvement this was the most troublesome bar on the river below Fredericksburg Bar, and steamers often grounded here.

Pratt Reach Bar, 103 miles above the mouth and 3 miles below Fredericksburg. The ruling depth before improvement was 8.1 feet, and the length between the 10-foot curves about 1,000 feet. The bar is formed of sand and mud.

Bernard's Bar, 104 miles above the mouth and 2 miles below Fredericksburg. The ruling depth before improvement was 9.1 feet and the length between the 10-foot curves about 400 feet. The material is sand and gravel.

Pollock's Bar, 105 miles above the mouth of the river and one mile below Fredericksburg. The bar was about 700 feet long in 1882, before its improvement was commenced, and the ruling depth 7 feet. At the head of the bar and near the right bank there was a ledge of rock on which the depth was from 6 to 7 feet.

Fredericksburg Bar.—This bar commences 1 mile below the railroad bridge at Fredericksburg, and extends up to and along the entire wharf front of the town to the bridge. The ruling depth in 1871 was 4 feet. The bar was formed and is constantly renewed by deposits of sand brought down by the recurring freshets. In 1871 six wrecks obstructed the channel over this bar.

The navigation of the Rappahannock is sometimes obstructed by trees and snags carried into the river by freshets.

PLAN OF IMPROVEMENT.

The original project, approved in 1871, was to secure a channel 100 feet wide and 10 feet deep by dredging and the construction of dikes from Fredericksburg to Tappahannock, the wrecks obstructing the channel to be removed. The first estimate of the cost of this improvement was $83,760. In 1879 the project was amended so as to provide for dredging a channel 100 feet wide and 10 feet deep through the bars between Fredericksburg and Port Royal, and one 200 feet wide and 15 feet deep between Port Royal and Tappahannock for a larger class of vessels. The depths secured by dredging were to be maintained by a system of wing dams and training dikes. The total estimated cost of the revised project was $381,500.

WORK DONE AND RESULTS OBTAINED.

The first appropriation for the improvement was made March 3, 1871, amounting to $15,000. From March 3, 1871, to June 30, 1890, 14 appropriations had been made, ranging from $5,000 to $25,000, and aggregating $199,500. These appropriations have been expended in improving the seven bars between Fredericksburg and Port Royal, by dredging, the construction of dikes, and the removal of wrecks and snags.

The following table gives the results of the improvement at each of the bars in January, 1890:

Locality.	Depth at low water before improvement.	Least channel depth at low water January, 1890.
	Feet.	*Feet.*
Fredericksburg Bar, below steamboat wharf	*4.0	†8.0
Pollock Bar	7.3	9.0
Bernard Bar	8.5	9.0
Pratt Bar	8.3	9.0
Spottswood Bar, upper	6.0	8.5
Spottswood Bar, lower	6.0	8.0
Castle Ferry Bar	8.0	9.5
Farley Vale Bar	8.0	9.5

*About.

† A small bar exists at and immediately below the steamboat wharf, at which the least depth is about 6.5 feet; but it is comparatively unimportant, since it is just at the head of navigation.

Stated in general terms, about two-thirds of the work to be accomplished under the project between Fredericksburg and Farley Vale, a distance of 12.6 miles, has been done.

Nothing has been done towards the improvement of the bars at Nanzatico Reach, 33 miles below Fredericksburg, and near Tappahannock, 61 miles below Fredericksburg. It is considered more important to first complete the improvement above.

This work was transferred to my charge by Mr. S. T. Abert, U. S. agent, on July 10, 1890.

An appropriation of $15,000 was made in the river and harbor act of September 19, 1890. During the fiscal year ending June 30, 1891, the following work has been done:

Repairs of dikes.—At Fredericksburg Bar breaks in dikes 1, 2, and N, and an addition of 15 feet made to Dike D.

At Pollock Bar, dikes 1 and 2 have been repaired and mattressed.

At Bernard Bar the dike has been raised on the upstream side, and more stone placed in the crib.

At Spottswood Bar a break in Dike 4½ has been repaired, and the dike mattressed at the end.

At Castle Ferry Bar, dikes 1, 2, ond 3 have been repaired. Forty-four feet of new sheet pile dike have been built at dike No. 3, to restore its original length. The ends of these dikes have been mattressed.

Dredging.—Under date of January 20, 1891, proposals were invited by public advertisement for dredging at Fredericksburg Bar, but none were received. On April 20, 1891, the dredging was again offered for contract, bidders being given the option of depositing behind the dikes on the Fredericksburg Reach, or dumping in the river below Woodyard Creek, a distance of about 14 miles. As the amount of work was small the dredging at Fredericksburg Bar and at Urbana Creek were offered under one contract. The following proposal was received May 20, 1891:

Frank C. Somers, Camden, N. J., 31 cents per cu. yd	$4,960

The contract was awarded to Frank C. Somers, of Camden, N. J., and entered into May 28, 1891. Under this contract it is proposed to dredge a channel 10 feet deep, and of such width as the funds permit, through the shoaler parts of Fredericksburg Bar. With the limited funds available only a small part of the dredging needed can be done. The date for commencing work is July 15, 1891.

Construction of pile driver and snag boat.—A combined steam derrick boat and pile driver was purchased in 1881 for the repair of dikes and removal of snags, etc., the plant having been also used as needed on the Mattaponi and Pamunkey rivers. As stated in the last Annual Report the plant had become worn out. It was therefore necessary to replace it by a new plant. During the winter of 1890–'91 plans for a new plant were prepared, to consist of one combined steam derrick boat and pile driver, one scow, and two flat boats. Proposals for the construction of the plant were invited and the following bids received April 6, 1891:

H. T. Morrison & Co., Petersburg, Va	$6,129.75
Thomas E. Wallace, Wilmington, N. C	7,400.00
A. M. Lawson & Co., Washington, D. C	7,181.70

The contract was awarded to H. T. Morrison & Co., of Petersburg, Va., and entered into April 24, 1891. The date fixed for the completion of the work was June 15, 1891. The contractors were, however, unable to complete the plant at that date, and were granted an extension until July 15, 1891. At the end of the fiscal year (June 30, 1891) the plant was nearly finished. One-half of the cost will be paid from the appropriation for Rappahannock River, one-fourth from the appropriation for the Mattaponi River, and one-fourth from the appropriation for the Pamunkey River.

FUTURE OPERATIONS.

The work remaining to be done under the project is the improvement of the two bars between Port Royal and Fredericksburg, and the dredging and dike construction necessary to secure and maintain a channel 10 feet deep and 100 feet wide through the 7 bars between Fredericksburg and Port Royal. As each freshet brings new deposits of sand and silt into the river, an annual appropriation of about $7,500 will be required for its maintenance.

APPROPRIATIONS.

The following appropriations have been made:

March 3, 1871	$15,000	March 3, 1881	$15,000
June 10, 1872	15,000	August 2, 1882	17,000
March 3, 1873	15,000	July 5, 1884	20,000
June 23, 1874	7,000	August 5, 1886	20,000
March 3, 1875	5,000	August 11, 1888 ($15,000, of which $3,000 was for Urbana)	12,000
August 14, 1876	10,000	September 19, 1890	15,000
June 18, 1878	13,500		
March 3, 1879	10,000		
June 14, 1880	25,000		214,500

The work is in the collection district of Tappahannock, which is the nearest port of entry. The nearest light-house is Bowler Rock light-house in the fifth light-house district.

Money statement.

July 1, 1890, balance unexpended		$2,527.77
Amount appropriated by act approved September 19, 1890		15,000.00
		17,527.77
June 30, 1891, amount expended during fiscal year		3,364.94
July 1, 1891, balance unexpended		14,162.83
July 1, 1891, outstanding liabilities	$2,419.67	
July 1, 1891, amount covered by uncompleted contracts	8,024.88	
		10,444.55
July 1, 1891, balance available		3,718.28
Amount (estimated) required for completion of existing project		167,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

It is reported that there has been a steady diminution in railroad rates, due to competition by water.

	Tons.
The tonnage for 1888 is reported as	83,600
The reports for 1890 are not regarded as altogether reliable, but from them the tonnage for 1890 is estimated at	83,830

J 9.

IMPROVEMENT OF URBANA CREEK, VIRGINIA.

ORIGINAL CONDITION.

Urbana Creek is a tributary of the Rappahannock River, which it enters 16 miles above the mouth. Navigation was obstructed in 1874 by a bar outside the mouth, over which but 6.5 feet could be carried. In 1882, after the improvement had been commenced, a shoal within the creek, having a least depth of 7 feet, and near the town of Urbana, was regarded as an obstruction to steamboat navigation.

PLAN OF IMPROVEMENT.

The approved project, adopted in 1879, was the excavation of a channel 150 feet wide and 10 feet deep through the outer bar, at an estimated cost of $20,000. The project was modified in 1883 so as to include dredging a channel through the shoal within the creek, and in 1888 so as to include a system of dikes or jetties along the sand spit at the mouth to prevent the natural channel from closing. The revised estimate for the entire project was $34,580.

WORK DONE AND RESULTS OBTAINED.

From March 3, 1879, to August 11, 1888, five appropriations ranging from $2,500 to $5,000 and aggregating $18,500 were made and expended in dredging channels through the bar outside the mouth, and the shoal within the creek, and in the construction of dikes and jetties on the sand spit. From 1883 to 1889 work was suspended for want of funds. In 1882 the channel through the outer bar had been dredged to a width of 140 feet and a depth of 10 feet, but owing to the action of storms and the cessation of work the width has diminished to 90 feet. The natural channel has been widened at the end of the sand spit, and at the turn just outside the spit. A channel 10 feet deep and from 80 to 170 feet wide has been dredged at the shoal inside the creek. Two jetties and a dike have been built on the sand spit.

On July 10, 1890, this work was transferred to my charge by Mr. S. T. Abert, U. S. Agent. The river and harbor act approved September 19, 1890, appropriated $3,000 for continuing the improvement. The most advantageous application of this appropriation seemed to be the widening of the channel at and near the end of the sand spit by dredging, and the construction of additional jetties to arrest the movement of sand along the beach, and the consequent shoaling of the channel.

Proposals for dredging were invited by public advertisement, and the following received February 21, 1891:

Baltimore Dredging Company, Baltimore, Md., 30 cents per cu. yd..........	$2,250
Fred. L. Somers, Washington, D. C., 29 cents per cu. yd..................	2,175
Chester T. Caler, Norfolk, Va., 32 cents per cu. yd......................	2,400

The prices were regarded as too high, and the bids were rejected.

The work was again offered for contract on April 20, 1891, together with the dredging at Fredericksburg, on the Rappahannock River. The following is an abstract of proposals received May 20, 1891:

Frank C. Somers, Camden, N. J., 26.5 cents per cu. yd..................	$1,987.50

The contract was awarded to Frank C. Somers of Camden, N. J., at 26.5 cents per cubic yard, and entered into May 28, 1891. The date for the commencement of work is September 15, 1891.

It is proposed to build the jetties by hired labor, using the new combined pile-driving and snagging plant, now under construction, when available. This plant will be used first on the Mattaponi and Pamunkey Rivers, and toward the close of the season will be brought around to the Rappahannock.

FUTURE OPERATIONS.

For the completion of the work under the existing project there remains the further dredging of the channel through the outer bar and the shoal within the creek and the construction of jetties. Owing to the exposed position of the outer bar it will be difficult to maintain a channel through it. Past experience shows that without protecting works a dredged channel must eventually shoal from the action of east to northeast storms, while protecting works in such an exposed locality must necessarily be expensive. While the improvement made has been of benefit to navigation by permitting the entrance of sailing vessels to the creek, the steamers do not use the channel, but land at a wharf on the Rappahannock about 1.5 miles from the town. The pilots of steamers are opposed to entering the creek, as they find the bend in the natural channel just outside the spit difficult, if not dangerous, in northeast and northwest winds. If this improvement is to be continued, larger appropriations should be made. The amount required to complete the existing project is $13,080.

The following appropriations have been made:

March 3, 1879	$5,000
June 14, 1880	2,500
March 3, 1881	4,000
August 2, 1882	4,000
August 11, 1888 (included in appropriation of $15,000 for Rappahannock River)	3,000
September 19, 1890	3,000
	21,500

Urbana is a port of entry in the collection district of Tappahannock.

Money statement.

Amount appropriated by act approved September 19, 1890		$3,000.00
July 1, 1891, balance unexpended		3,000.00
July 1, 1891, outstanding liabilities	$100.00	
July 1, 1891, amount covered by uncompleted contracts	1,987.50	
		2,087.50
July 1, 1891, balance available		912.50
Amount (estimated) required for completion of existing project		13,080.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		13,080.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

It is reported that larger vessels can enter the creek now than formerly and that lower freight rates are secured.

The tonnage for the calendar year 1890 is reported as 5,850 tons.

J 10.

IMPROVEMENT OF YORK RIVER, VIRGINIA.

ORIGINAL CONDITION.

The York River is formed by the union of the Mattaponi and Pamunkey rivers at West Point, Va., is 41 miles in length, and empties into Chesapeake Bay about 16 miles above Old Point. Entering the river. 24 feet can be carried for 32 miles up to Potopotank Bar, 9 miles below West Point. In 1880 the ruling depth on this bar was 18.5 feet, and its length between the 20-foot curves was 2,200 feet. The next obstruction to navigation is West Point Bar, which commences about 2 miles below West Point and extends up to West Point. West Point is the shipping point of the Richmond and West Point Terminal Railroad system. The wharves from which shipments are made are built within the mouth of the Pamunkey River, and further obstruction to navigation was found in shoal water in front of these wharves.

PLAN OF IMPROVEMENT.

The original project, adopted in 1880, proposed the dredging of a channel 22 feet deep and 200 feet wide through the bars at Potopotank and West Point, with an increased width at the wharves at West Point. In 1884, on account of the increased trade, the project was modified by increasing the width of the proposed channel to 400 feet at a total estimated cost of $256,000. In 1887 the project was again amended to include the construction of a dike along the right bank of the river at West Point Bar, in order to prevent the deposit of silt in the dredged channel. The estimated cost of this dike was $52,800, making the total estimated cost of the improvement $308,800.

WORK DONE AND RESULTS OBTAINED.

From June 14, 1880, to August 11, 1888, six appropriations, ranging from $10,000 to $30,000, and aggregating $128,750, were made for this improvement.

Up to June 30, 1890, the following work had been done: A channel 105 feet wide and 22 feet deep was dredged in 1880–'81 through Potopotank Bar, 58,809 cubic yards of materal having been dredged, at 15 cents per cubic yard. This channel in January, 1890, had a depth of from 20.8 to 21.7 feet.

At West Point Bar 795,704 cubic yards were dredged from 1881 to 1889 under successive appropriations at rates varying from 8.5 to 16 cents per cubic yard, which gave a channel through the bar with a width varying from 161 to 257 feet, and a depth, exclusive of the center cut, of not less than 22 feet. Under a modification of the project by the Secretary of War, January 4, 1889, a cut 40 feet wide and 24 feet deep was dredged near the center of the channel from the lower wharf at West Point to the second turn in the channel. In January, 1890, the ruling depth in this cut had been reduced by silting to 20.6 feet and in the rest of the channel to 19 feet. From the commencement of the improvement in 1881 to June 30, 1890, it has been necessary to redredge 152,595 cubic yards of silting which was not provided for in the original estimate, or about one-fifth of the total amount dredged at West Point Bar. The total amount expended to June 30, 1890, was $127,489.27.

This work was transferred to my charge by Mr. S. T. Abert, U. S. Agent, on July 10, 1890. In the river and harbor act approved September 19, 1890, an appropriation of $30,000 was made for continuing the improvement. Under date of January 20, 1891, proposals for dredging at West Point Bar were invited by public advertisement. The specifications for the work provided that the material dredged from the channel should be deposited along the flats on the right of the channel. A trench was first to be dredged along the proposed line of dike, and the material deposited on the side of the trench, so as to form an embankment. This trench was to serve as the dumping place for the material dredged from the channel; the embankment or earthen dike to commence at the shore near Ferry Creek and extend downstream parallel to the channel and near the outer edge of the flats for a distance of about 6,000 feet, and was intended to contract the water way and prevent the shoaling of the dredged channel. The following bids were received February 21, 1891:

Baltimore Dredging Company, Baltimore, Md., 14⅞ cents per cu. yd....	$25,287.50
Atlas Dredging Company, Wilmington, Del., 17 cents per cu. yd........	28,900.00
Chester T. Caler, Norfolk, Va., 17.25 cents per cu. yd..................	29,325.00
American Dredging Company, Philadelphia, Pa., 16 cents per cu. yd....	27,200.00
George C. Fobes & Company, Baltimore, Md., 15.5 cents per cu. yd.....	26,350.00
Frank C. Somers, Camden, N. J., 16.5 cents per cu. yd.................	28,050.00

The contract was awarded to the Baltimore Dredging Company, of Baltimore, Md., and entered into March 9, 1891, the price for dredging the material from the channel and depositing it in embankment as above described being 14⅞ cents per cubic yard. The contractors commenced work March 20, 1891, with two clam-shell dredges, which were placed at work dredging the trench along the flats and forming the embankment, and continued until the 1st of May, when it was found that owing to the soft nature of the material forming the bed of the river, the contractors could not form an embankment with the dredging plant owned by them. These dredges were first-class machines for ordinary dredging, but for this particular work in the very soft material found, they were not suited. After working about 6 weeks in a fruitless effort to form an embankment the president of the company addressed me a letter saying that the work of forming an embankment, as provided by the specifications, was impracticable, and requested that the contract be annulled or amended.

An offer was made to do the channel dredging at 9 cents per cubic yard, the material to be dumped at such locality as would be satisfactory to the engineer. The price was a low one. The construction of the dike was impracticable with the tools at hand. It was believed to be impracticable to raise it to a height to be of any service in controlling the currents by any other machinery, and the necessity for dredging the channel at once was imperative. Under the circumstances it seemed preferable to amend the contract, saving the sum of about $10,000 to be applied to the construction of a dike in some other way, and a supplemental agreement was entered into May 11, 1891. Under this modified contract dredging was commenced in the channel in front of the West Point wharves June 10, 1891, and at the close of the fiscal year was still in progress, two cuts of 40 feet each having been completed from the lower to the upper wharf. Examinations of the channel show that shoaling has continued in the channel near the first turn, so that the ruling depth is now but 18 feet. Some shoaling has also occurred in front of the West Point wharves. Over 100,000 cubic yards of redredging will be required under the present appropriation.

FUTURE OPERATIONS.

Future operations proposed are the completion of the channels at West Point and Potopotank bars and the construction of the dike at West Point Bar. The dike will be commenced with the present appropriation but should be continued as soon as further funds are available in order to maintain the channel secured by dredging.

Occupants of oyster beds on these flats object to the construction of the dike, and claim that it will injure their oyster beds.

On the basis of the original estimate the amount required for the completion of the project is $150,050, but owing to the continued shoaling of the channel this amount will probably be insufficient. After the close of the dredging now in progress a new survey of West Point Bar will be made and the estimates revised. The trade of the York River is large, increasing, and important, and the improvement is worthy of liberal appropriations by Congress.

APPROPRIATIONS.

The following appropriations have been made:

June 14, 1880	$10,000
March 3, 1881	25,000
August 2, 1882	25,000
July 5, 1884	20,000
August 5, 1886	18,750
August 11, 1888	30,000
September 19, 1890	30,000
Total	158,750

The work is in the collection district of Richmond, which is the nearest port of entry. The nearest light-house is Bell Rock, in the fifth light-house district.

Money statement.

July 1, 1890, balance unexpended		$1,300.73
Amount appropriated by act approved September 19, 1890		30,000.00
		31,300.73
June 30, 1891, amount expended during fiscal year		2,420.90
July 1, 1891, balance unexpended		28,879.83
July 1, 1891, outstanding liabilities	$500.00	
July 1, 1891, amount covered by uncompleted contracts	15,300.00	
		15,800.00
July 1, 1891, balance available		13,079.83
Amount (estimated) required for completion of existing project		150,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments during 1890.

Articles.	Receipts.	Shipments.	Total.
	Tons.	*Tons.*	*Tons.*
Coal	....	16,375	16,375
Cotton	....	74,002	74,002
Farm produce	....	2,500	2,500
Iron	....	44,825	44,825
Lumber	....	25,854	25,854
Oysters	....	50,000	50,000
General merchandise	107,465	67,915	175,380
Ties	....	9,400	9,400
Tobacco	....	7,704	7,704
Wood	....	12,150	12,150
Total	107,465	310,725	418,190

Vessels arriving and departing during 1890.

Steamers drawing 10 feet or more	683
Steamers drawing less than 10 feet	208
Vessels drawing 10 feet or more	99
Vessels drawing less than 10 feet	250
Barges, flatboat, etc	25

Statement of tonnage by years.

	Tons.
Reported for 1888	285,480
Reported for 1889	328,353
Reported for 1890	418,190

No new lines of transportation were established during 1890.

J 11.

IMPROVEMENT OF MATTAPONI RIVER, VIRGINIA.

The Mattaponi River is navigable for small steamers and vessels from its mouth at West Point to Ayletts, a distance of about 52 miles, and can be made navigable for barges for 26 miles above Ayletts, to Munday Bridge. The obstructions to 5½-foot navigation below Ayletts are as follows:

Designation.	Approximate distance below Ayletts.	Length of bar.	Ruling depth.
	Miles.	*Feet.*	*Feet.*
Latano Bar	11	2,900	3.6
Robinson Bar	8	3,500	3.4
Presque Isle Bar	7	1,200	2.0
Sale Bar	6½	800	2.0
Walker Bar	4	1,000	2.5
Old Hall Bar	1	900	2.5

Of the above-named bars only the first two have been surveyed, and the lengths and depths at the others are approximate only. Above Ayletts there were eight bars, but no work on them was proposed. The river was also obstructed by snags, overhanging trees, and wrecks.

PLAN OF IMPROVEMENT.

The proposed plan of improvement was to remove snags, logs, leaning trees, wrecks, etc., below Munday Bridge, and to improve the bars below Ayletts so as to give a depth of 5.5 feet at low tide, and a channel width of 40 feet.

WORK DONE AND RESULTS OBTAINED.

From June 14, 1880, to August 11, 1888, five appropriations, ranging from $2,500 to $5,000 and aggregating $16,300, had been made for this work, and the entire amount expended. On June 30, 1890, the following results had been obtained: Snags, wrecks, and overhanging trees had been removed from Robinson Bar to Munday Bridge, a distance of about 34 miles, and 2,226 linear feet of dike had been built at Robinson Bar. No dredging has yet been done on the river. The improvement was transferred to my charge by Mr. S. T. Abert, United States agent, July 10, 1890. In the river and harbor act approved September 19, 1890, an appropriation of $3,000 was made, $1,500 of which could be expended above Ayletts. As this amount was insufficient for dredging operations it was recommended that it be applied to the removal of snags, logs, and similar obstructions which accumulate each year and obstruct navigation. The plant formerly used for this purpose on the Rappahannock, Mattaponi, and Pamunkey Rivers had become worn out, and it became necessary to build a new plant before snagging could be commenced. Plans were prepared and proposals invited for the construction of a plant consisting of one combined steam hoister and pile-driver, one scow, and two flat boats. An abstract of bids received will be found in the report for the Rappahannock River. A contract was entered into with H. T. Morrison & Co., of Petersburg, Va., and at the close of the fiscal year the plant was nearly completed. It is proposed to commence the removal of snags, etc., in the Pamunkey in July, 1891, and then take the plant around to the Mattaponi and remove similar obstructions there.

FUTURE OPERATIONS.

The remaining work under the existing project is as follows: The completion of the dikes at Robinson Bar and the construction of those proposed at Latane Bar, and the dredging of channels at all of the bars below Ayletts having a ruling depth of less than 5.5 feet. Snags and fallen trees accumulate each year and will require removal. The estimated amount required for the completion of the existing project is $52,800, but as instrumental surveys have been made of but 2 bars this estimate will be subject to future revision.

APPROPRIATIONS.

The following appropriations have been made:

June 14, 1880	$2,500
March 3, 1881	3,300
July 5, 1884	2,500
August 5, 1886	5,000
August 11, 1888	3,000
September 19, 1890	3,000
Total	19,300

The work is in the collection district of Richmond, which is the nearest port of entry. The nearest light-house is Bell Rock, Virginia.

Money statement.

July 1, 1890, balance unexpended		$3.11
Amount appropriated by act approved September 19, 1890		3,000.00
July 1, 1891, balance unexpended		3,003,11
July 1, 1891, outstanding liabilities	$50.00	
July 1, 1891, amount covered by uncompleted contracts	1,532.44	
		1,582.44
July 1, 1891, balance available		1,420.67
Amount (estimated) required for completion of existing project		52,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The receipts and shipments for the calendar year 1890 are reported as follows:

	Tons.
Lumber	7,700
Merchandise	10,400
Ties	6,900
Wood	7,650
	32,650

J 12.

IMPROVEMENT OF PAMUNKEY RIVER, VIRGINIA.

The Pamunkey River is navigable from its mouth at West Point, on the York River, to Hanovertown or Dabney Ferry, a distance of about 59 miles. Seven feet can be carried to Piping Tree Ferry, a distance of 43 miles. The following are the principal bars obstructing navigation:

Designation.	Distance above West Point.	Length of bar.	Least depth.
	Miles.	*Feet.*	*Feet.*
Spring Bar	43.5	700	5.6
Skidmore Bar	47.5	600	5.8
Whale Back Bar	53.5	700	3
Potomoy Creek	56	400	1.5
Indian Table	58	....	(*)

* Exposed at low tide.

In addition to these bars navigation was originally obstructed by numerous wrecks, logs, snags, and overhanging trees.

PLAN OF IMPROVEMENT.

The project for the improvement, adopted in 1880 and amended in 1885, provides for 7-foot navigation from West Point to Basset Ferry, 47 miles, thence 5-foot navigation to Wormley Landing, 54 miles above West Point, and thence 3-foot navigation to Hanovertown, the 7-foot channel to be 100 feet wide and the remainder 40 feet wide. The wrecks, snags, logs, and trees obstructing navigation between Garlick Ferry and Hanovertown were also to be removed.

WORK DONE AND RESULTS OBTAINED.

From June 14, 1880, to August 11, 1888, five appropriations were made, ranging from $2,500 to $5,000, and aggregating $15,500. The following work has been done: Snags, logs, and overhanging trees have been removed from the river between Hanovertown and Garlick Ferry, a distance of 22.5 miles. Parts of wrecks obstructing navigation have been removed as follows: Three at Skidmore Bar, three at Carter Island, and one at White House. Nine hundred and eleven feet of dike have been constructed at Skidmore and Spring bars, and a channel 800 feet long, 95 feet wide, and from 6 to 7 feet deep has been dredged through Skidmore Bar.

This improvement was transferred to my charge by Mr. S. T. Abert, U. S. agent, on July 10, 1890.

The river and harbor act approved September 19, 1890, appropriated $3,000 for continuing the improvement. This amount was too small to be advantageously applied to dredging operations. The removal of snags, logs, and overhanging trees, which are brought into the river each year by freshets, was, however, needed, and it was proposed to apply the funds to this work. The plant formerly used on the Rappahannock, Mattaponi, and Pamunkey rivers was worn out, and it was necessary to build a new one before active operations could be commenced. Plans were prepared and proposals invited for a plant, to consist of a combined steam-hoister and pile-driver, one scow, and two flatboats. An abstract of the bids received will be found in the report for Rappahannock River. One-fourth of the cost of the plant, or about $1,600, will be charged to the appropriation for the Pamunkey River. It is expected that the plant will be delivered at West Point, Va., about July 15, 1891, when the removal of snags, etc., will be commenced.

FUTURE OPERATIONS.

The work remaining to complete the project is the dredging of channels at Spring Bar and at the three bars above, with such further work in removing obstructions as may be found necessary. The estimated cost of completing the project is $10,000.

APPROPRIATIONS.

The following appropriations have been made:

June 14, 1880	$2,500
March 3, 1881	2,500
August 2, 1882	2,500
August 5, 1886	5,000
August 11, 1888	3,000
September 19, 1890	3,000
Total	18,500

The work is in the collection district of Richmond, which is the nearest port of entry. The nearest light-house is Bell Rock, Va.

COMMERCIAL STATISTICS.

Satisfactory separate statements of the trade of the river could not be obtained, but nearly all the tonnage is thought to be included in that of the York River, as the trade of the Pamunkey practically all passes through the York.

Money statement.

July 1, 1890, balance unexpended		$16.36
Amount appropriated by act approved September 19, 1890		3,000.00
July 1, 1891, balance unexpended		3,016.36
July 1, 1891, outstanding liabilities	$50,00	
July 1, 1891, amount covered by uncompleted contracts	1,532.44	
		1,582.44
July 1, 1891, balance available		1,433.92
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

J 13.

PRELIMINARY EXAMINATION OF ST. LEONARD CREEK, MARYLAND.

[Printed in House Ex. Doc. No. 120, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 20, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated December 18, 1890, from Lieut. Col. Peter C. Hains, Corps of Engineers, giving results of preliminary examination of St. Leonard Creek, Maryland, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains thinks little additional traffic, if any, would be developed by deepening the channel, even if it were deepened to the head of the creek, and therefore is of opinion that St. Leonard Creek is not worthy of improvement by the National Government. I concur in this view.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., December 18, 1890.

GENERAL: In compliance with the instructions contained in Department letter dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of St. Leonard Creek, Maryland:

St. Leonard Creek is a tidal estuary of the Patuxent River. There is deep water at its mouth and for a couple of miles upstream. Beyond this the depth diminishes, till at a distance of about 6 miles from its mouth the depth is only about 3 feet. There are two wharves, Mackall and Soller, near the mouth; another, called Planter Wharf. is about 3 miles higher up. Formerly steamers made landings at the latter place. They have not done so, however, for several years past. There is considerable trade on the lower part of St. Leonard Creek. and but little on the upper part. A line of steamers runs from Baltimore to the Patuxent River, and these touch at the wharves on the lower part of the creek. At the present time there is ample depth of water for vessels of about 10 feet draft nearly up to Planter Wharf, but there is difficulty in turning at and near this point.

The Drum Point Railroad (in process of construction) will pass within about 5 miles of the mouth of the creek. At the present time, the trade is made up of shipments of tobacco and wood, railroad ties, poplar, fruit. oysters, and some grain; the imports are general merchandise. No improvement to the navigation is needed on the lower part, and it is estimated that the total value of shipments from the upper part will not exceed in value $21,000 annually. The cost of improving the navigation of the upper part has not been estimated, but it is safe to say it would cost more than the total annual trade to be benefited. The adjacent country is fertile, but ample facilities for navigation already exist. I think but little, if any, additional traffic would be developed by deepening the channel, even if it were deepened to the head of the creek.

I am therefore of the opinion that St. Leonard Creek, Maryland, is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 14.

PRELIMINARY EXAMINATION OF ST. JEROME BAY, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., April 22, 1891.

GENERAL: In compliance with instructions contained in Department letter dated September 20, 1890, I submit the following report of a preliminary examination of St. Jerome Bay, Maryland.

St. Jerome Bay is formed by a small indentation in the westerly side of Chesapeake Bay, and St. Jerome Creek empties into the head of the bay. In 1880 a survey was made for deepening the entrance to the creek. The improvement that was recommended was for the benefit of the Fish Commission, which proposed to establish a place for propagating oysters. At that time there was only about 3 feet of water on the bar beyond the entrance, while directly at the mouth of the creek there was a depth of 16 feet. The first project contemplated dredging a channel 100 feet wide and 9 feet deep through the outer bar, and a channel 40 feet wide and 6 feet deep through the south prong of the creek. The estimated cost of the project was $6,500. Subsequently this estimate was increased to $21,500. Still later the estimate was increased to $26,500. In 1884 an appropriation of $15,000 was expended, when the estimate was again increased to $52,500. In 1888 the estimate was again increased to $61,200. In 1889 the Fish Commission abandoned the station. The total amount expended on the improvement was $26,500 and resulted in giving a channel 9 feet deep and 140 feet wide at the bar outside the creek, and a channel 3½ feet deep and 30 feet wide in the South Prong. The present condition of the entrance shows that the outer channel has filled up to some extent.

The improvement now desired by citizens residing in the vicinity, and fishermen who frequent these waters, is that the outer channel be made 10 feet deep, and about 300 feet wide, and that a turning basin be dredged within the mouth of the creek. This is desired as much for a harbor of refuge as for any other purpose. The trade in the creek is chiefly in oysters, and it is said that as many as 10,000 bushels are shipped from there annually. There is also some trade in the produce of the country, which consists of grain, tobacco, railroad ties, etc., the amount of which was not ascertainable. To make the improvement now desired I estimate would cost about $46,000, but it is scarcely probable that a dredged channel would maintain itself without works of contraction, consequently an annual outlay would be needed for maintaining the improvement. In my opinion the commerce of the place does not justify the Government in undertaking the work. As to its availability as a harbor of refuge for small sailing vessels in southeasterly gales, it may be said that it would occasionally be useful to them, but unless the bar be kept deep enough by frequent dredging, it might become a source of danger. The distance from St. Jerome Bay to Cornfield Harbor is less than 5 miles, and here is an excellent harbor in northeasterly gales. The distance to the nearest harbor to the northward, the mouth of the Patuxent River, is about 15 miles.

In view of all the circumstances, I am of the opinion that St. Jerome Bay is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U S. A.

J 15.

PRELIMINARY EXAMINATION OF PISCATAWAY CREEK, MARYLAND.

[Printed in House Ex. Doc. No. 49, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated October 6, 1890, by Lieut. Col. Peter C. Hains, Corps of Engineers, giving results of preliminary examination of Piscataway Creek, Maryland, made to comply with the provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains reports that, in his opinion, Piscataway Creek is not worthy of improvement by the National Government, and in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., October 6, 1890.

GENERAL: In compliance with Department order of September 20, 1890, relative to preliminary examinations of certain harbors and rivers in my district, I have to report that I have made a preliminary examination of Piscataway Creek, Maryland, with a view to determining whether said creek is worthy of improvement by the National Government. Piscataway Creek, Maryland, is a tributary of the Potomac River, which it enters from the east about one-fourth of a mile below Fort Washington Wharf and 12 miles below Washington.

The creek is about five-eighths of a mile wide at its mouth, and from one-half to five-eighths of a mile wide up to Farmington Wharf, the only wharf on the creek. For a distance of 2 miles from the mouth the creek has the character of a tidal estuary or bay. There is a bar at the mouth over which about 3.5 feet can be carried at low tide; from thence to the Farmington Wharf the depth varies from 4 to 6 feet. The average depth holds for nearly the full width of the creek and the tidal space is large and ample. About one-fourth of a mile above Farmington Wharf the creek becomes more fluvial in its character and narrows to about 100 feet, being bordered by wide marshes. There is a bar where the narrow stream debouches, over which but 6 inches can be carried. Above this bar the depth ranges from 2.5 to 3.5 feet, the natural depth having been increased by sand dredging. About 1.5 miles above Farmington the width decreases to 50 feet. At Piscataway village, some 3.5 miles above Farmington, the width is 25 feet and the depth from 6 inches to 1 foot.

The steamer *Harry Loder* plies between Farmington and Alexandria, Va.; she is about 80 feet long, 22 feet wide, and draws 3 feet light and from 3.5 to 4 feet loaded. Her tonnage is 23 tons net. The steamer runs every other day, as the trade is not sufficient to warrant daily trips. The obstructions to navigation by this steamer are, (1) the bar at the mouth of the creek, and (2) a shoal place directly in front of the Farmington Wharf. The steamer experiences but little difficulty at ordinary low tides, but during northwest winds, when the tide falls from 1 to 2 feet below the normal plane, the boat can not cross the bar. Comparison with the Coast Survey soundings of 1862 indicates a very gradual shoaling on the bar since that date.

The depth at Farmington Wharf is about 3 feet, but in the channel off the wharf there is a depth of 4.2 feet. The proper remedy for this trouble is to extend the wharf.

The navigation could be improved by dredging a channel through the bar at the mouth, say, 6 feet deep and 100 feet wide, and another near the Farmington Wharf, where the depth is only 4.5 feet. Such dredged channels would cost about $12,000.

The trade is in grain, tobacco, cord wood, and supplies for stores. There is no trade above Farmington Wharf. There are three houses and a store at and near Farmington. A road leads from Farmington to Piscataway, about 3.5 miles. Piscataway is a dilapidated village of some twenty houses, about one-third of which are untenanted or in a state of decay. The population is less than 100. There is a church and four small stores, which are said to do an annual business of $4,000 a year. It was estimated that some 80,000 pounds of tobacco were raised annually in this district. Brandywine Station, on the Popes Creek

Branch of the Baltimore and Potomac Railroad, is 8 miles east of Piscataway, and the railroad probably takes much trade which formerly went by water. It is estimated that the trade of the creek is about from $10,000 to $12,000 per year. While it is possible that some trade might be developed by improving the navigation, it is, in my opinion, too local in its character and too insignificant in its proportions to justify the General Government in undertaking the work, and in my opinion "not worthy of improvement" by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 16.

PRELIMINARY EXAMINATION OF NEWPORT CREEK, HEAD OF WICOMICO RIVER, CHARLES COUNTY, MARYLAND.

[Printed in House Ex. Doc. No. 169, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 9, 1891.

SIR: I have the honor to submit the accompanying copy of report dated January 6, 1891, by Lieut. Col. Peter C. Hains, Corps of Engineers, upon the preliminary examination of Newport Creek, head of Wicomico River, Charles County, Md., made in compliance with requirements of the river and harbor act of September 19, 1890.

It is the opinion of Lieutenant-Colonel Hains, concurred in by this office, that the locality is not worthy of improvement by the United States.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 6, 1891.

GENERAL: I have to report, in compliance with the requirements of Department letter of September 20, 1890, as follows in respect to a preliminary examination made of Newport Creek, at the head of Wicomico River, Charles County, Md.

This creek rises in the southeasterly part of Charles County, Md., flows in a southerly direction, and empties in the Wicomico River, about 3 miles from the head of the latter. For the greater part of its length the creek is an insignificant stream, with a supply of water wholly inadequate for purposes of navigation. That part of the creek near its mouth is deeper and wider, the width here being about 100 feet and the depth from 6 to 10 feet, forming a sort of pool about 1,500 feet in length. This part of the creek also receives a tidal flow from the Wicomico River, the rise and fall of tide being about 2 feet.

The land bordering on the stream near its mouth is low and marshy; higher upstream it is better drained and more rolling. The village of Newport, consisting of about a dozen houses, is located on the right bank about 1½ miles from the mouth.

Entrance to the creek is obstructed by a bar, part of which, in very low tides, becomes bare, but through which a shallow channel about 100 feet wide has cut its way. This bar is the obstruction to navigation, which, I presume, it is desired that the Government should remove. The upper part of the creek is too small to make the question of its improvement one for serious consideration. A cut through the bar would enable larger vessels to get into the deep pool near the mouth of the creek, and if made 200 feet wide and 6 feet deep at low tide could be done for about $12,000, but in all probability it would fill up unless works of contraction were also built. The cost of such works has not been estimated. It must be remembered, however, that the Wicomico itself has only from 3 to 4 feet depth at low tide on the upper part, and in consequence a deepening of the bar of Newport Creek would be of little use unless the river were also deepened.

From the best information obtainable it appears that there are only two or three small sailing vessels that trade on the creek. They receive their cargoes from lighters. The products of the valley consist of tobacco, corn, wheat, and cord wood. The amount, however, as nearly as could be ascertained, does not exceed in value $30,000 per annum, most of which goes to market by rail.

In view of the above I am of the opinion that Newport Creek is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 17.

PRELIMINARY EXAMINATION OF SMITH CREEK, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., April 22, 1891.

GENERAL: In compliance with instructions contained in Department letter dated September 20, 1890, I submit the following report of a preliminary examination of Smith Creek, Maryland.

Smith Creek is a small tidal estuary of the Potomac River, into which it empties about 8 miles northwest of Point Lookout. The creek, though small, is for the most part deep, and large quantities of oysters are shipped from it. There are three steamers that make triweekly trips to the two landings in the creek during the spring and summer season, and two steamers during the winter season. Besides these steamers there are many smaller vessels that trade there. So far as commerce is concerned, it is quite large considering the size of the stream, though I am not able to give any exact data in regard to the amount. Four hundred to 500 barrels of oysters are shipped per week in the oyster season.

The improvements wanted by the people, so far as I could learn, are lights to guide through the bar channel at night, or the straightening of the channel by dredging. The channel is crooked, it is true, but it is deep and not so narrow but that steamers can enter it at night by by means of the lanterns that are hung up on piles at its entrance. These temporary lights are maintained by private parties, and if they could be relieved of this trouble and expense, nothing more would be needed. The channel on the bar is at least 14 feet deep at low tide, in its shoalest parts, and about 7 feet is the greatest draft of vessels that ordinarily run into it. Inside the bar the depth is more than 18 feet.

The bar seems to be a stable one and has not varied much in a number of years. To dredge off a part of the shoal in order to make the channel wider and more nearly straight would not afford any material relief, as it would doubtless form again unless supplemented by works of contraction. If works of contraction be also constructed to give permanency to the channel, the cost would become so great in comparison to the advantage gained that the Government would not be justified in undertaking it.

In view of the above facts I am of the opinion that Smith Creek, Maryland, is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers.

J 18.

PRELIMINARY EXAMINATION OF NANDUA CREEK, VIRGINIA.

[Printed in House Ex. Doc. No. 290, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 2, 1891.

SIR: I have the honor to submit the accompanying copy of report dated February 27, 1891, from Lieut. Col. P. C. Haines, Corps of Engineers, giving results of preliminary examination of Nandua Creek, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains reports that he is of the opinion that Nandua Creek is not worthy of improvement at the present time by the National Government, and in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., February 27, 1891.

GENERAL: In accordance with instructions contained in Department letter dated September 20, 1890, I submit the following report of a preliminary examination of Nandua Creek, Virginia:

Nandua Creek, Virginia, is a small tidal estuary of Chesapeake Bay. on the eastern side of the same. The improvement asked for is a deepening of the bar at its entrance. This bar is a shifting one. The sand spit on the north side of the entrance seems to work to the southward during northwesterly gales, which stir up the material forming it, and while in this state of suspension it is moved along the bottom until the currents become too sluggish to carry it farther, when it is dropped and forms a bar.

The sand spit on the south side of the entrance also projects into the bay about half a mile, but the one on the north side overlaps the other, so that the channel is both narrow and crooked. It appears that the southerly end of the north sand spit which forms the bar moves slowly southward, forcing a corresponding movement of the channel until the latter reaches a distance of half or three-quarters of a mile from its most northerly position. It then breaks through in its original place, and the same southerly movement takes place again. The bar is thus kept constantly shifting.

At the present time there is a depth of about 6 feet on the bar at low tide, and though the channel is crooked, there do not appear to be any serious difficulties in navigating it. There is only one boat landing in the creek, and vessels drawing more than 6 feet can not reach it. It thus happens that a deepening of the bar would add little, if anything, to the facilities of navigation, except, perhaps, to make it easier of entrance. If the existing channel was well buoyed it would be a benefit.

The country tributary to Nandua Creek is fertile and well cultivated. The amount of produce shipped is large. Mr. Clarke, the agent of a line of steamers between Baltimore and Nandua, informs me that last year the steamers of that line transported 37,000 barrels of potatoes, besides large quantities of other farm produce, from Nandua to Baltimore. I am informed that the amount of freight of all kinds reaches 5,000 to 6,000 tons per annum. In value, I should judge, there must be a trade of from $125,000 to $150,000 per year.

If, therefore, there was serious danger of this trade being cut off by a filling up of the channel at the entrance of the creek, or if I could see how it could be largely increased by deepening that channel, I should say that Nandua Creek is worthy of improvement, if such improvement could be made at reasonable cost. But there does not appear to be any danger of its filling up or becoming any worse than it now is. On the contrary, it is probable that it will become better through natural agencies before an appropriation could be made to improve it. The prevalent opinion among the people seems to be that it would cost but a few thousand dollars to dredge a channel and that then it would remain there. A dredged channel would, however, be of the same shifting character as the natural one, unless it was supplemented with other works to regulate the flow of the tides. It is probable that a dike built out from the south side of the entrance, in connection with dredging, would make the channel more stable and possibly deeper.

I roughly estimate the cost of dredging a new channel 6 feet deep at extreme low tide, and 150 feet wide, at about $10,000. The dike would cost about $30,000, making the total cost of the improvement about $40,000. The expenditure of this amount at Nandua Creek would not, in my opinion, add sensibly to the existing facilities. I am therefore of the opinion that Nandua Creek, Virginia, is not worthy of improvement at the present time by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 19.

PRELIMINARY EXAMINATION OF POTOMAC CREEK, VIRGINIA.

[Printed in House Ex. Doc. No. 63, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 26, 1890, from Lieut. Col. Peter C. Hains, Corps of Engineers, giving results of preliminary examination of Potomac Creek, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains reports that, in his opinion, Potomac Creek is not at this time worthy of improvement by the National Government, and I concur in this opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., November 26, 1890.

GENERAL: In accordance with the instructions contained in Department letter dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Potomac Creek, Virginia.

Potomac Creek is a small tidal tributary of the Potomac River into which it empties about 45 miles below Washington, D. C. There is no less than 6 feet at its mouth, and this depth can be carried upstream a distance of about 2 miles. A bar about 6,000 feet long is then encountered over which only about 3 feet can be carried at low tide. After crossing this bar the creek becomes narrow and much deeper for several miles farther upstream. To make a cut through this bar, 6 feet deep at low tide, would open up the navigation of a small section of the creek to boats of greater draft than can now reach it, but it is of doubtful utility at the present time. The trade of the creek is carried on in light-draft sailing vessels, and consists chiefly of cord wood, railroad ties, and poplar for paper manufacturing. Grain is raised along the banks, but little, if any, is shipped by water. The Alexandria and Fredericksburg Railroad is near at hand, and doubtless carries most of the produce of the adjacent country. There are no steamers running into the creek, and even if the bar referred to was deepened it is my opinion there would be none.

It would cost about $30,000 to dredge a channel 200 feet wide and 6 feet deep through this bar, and it is almost certain that it would not be permanent, but would require redredging from time to time. A channel of less width would soon fill up, as the material is very soft.

I have not been able to obtain any reliable statistics of trade, but from personal observation and inspection of the country, I do not think it would be sufficient to justify the Government in undertaking the work of improvement.

For the reasons stated I am of the opinion that Potomac Creek, Virginia, is not at this time worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 20.

PRELIMINARY EXAMINATION OF UPPER MACHODOC CREEK, VIRGINIA.

[Printed in House Ex. Doc. No. 17, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 4, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated November 26, 1890, from Lieut. Col. Peter C. Hains, Corps of Engineers, giving results of preliminary examination of Upper Machodoc Creek, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains reports that, in his opinion, the Upper Machodoc is not worthy of improvement by the National Government, and I concur in this opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., November 26, 1890.

GENERAL: In accordance with the instructions contained in Department letter dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Upper Machodoc Creek, Virginia:

The Upper Machodoc is a small tidal tributary of the Potomac River, into which it empties about 3 miles below Mathias Point. At its mouth the creek is wide and from 6 to 8 feet of water at low tide can be carried up as far as Brick-house Landing, a distance of about 2 miles. A short distance above this landing there is a bar over which only 3½ feet can be carried and that with difficulty on account of its tortuous course and narrowness. After crossing this bar 7 to 8 feet of water can be carried for a distance of about half a mile. Here there is a lump over which only 5 feet can be carried. Thence to Little Ferry Landing, a distance of about 2 miles, 7 feet can be carried without difficulty, except at one place, where only 5 feet can be had. From Little Ferry Landing to Long Point there is deep water. At Long Point the channel is narrow and tortuous, and obstructed by some old logs, making navigation here dangerous. Above Long Point a shallow place occurs, called Cow Flats, extending to within a short distance of Oyster Shell Landing. On these flats the water is only 4 feet deep and obstructed by snags. Above Oyster Shell Landing the creek becomes narrower, but deeper, the width decreasing to about 70 feet.

If the obstructions to navigation were removed as far up as Oyster Shell Landing there would result some benefit to navigation and, incidentally, to the adjacent country. There is no railroad in this immediate section, so that water is the chief means of transportation. The principal products are railroad ties, cord wood, and some farm produce. Probably the trade may reach in value as much as $50,000 or $75,000 annually. This is an approximate estimate only. I have no definite statistics of trade.

To make navigation safe and easy for vessels, say, of 6 feet draft, would cost about $25,000 to $40,000, but I am of the opinion that the dredged channels would maintain themselves for a considerable time.

Trade is carried on in barges and light-draft schooners. No steamers enter the creek at present, though I am informed that one formerly did so. I do not think that any large increase in trade would result from the improvement. I have, therefore, to report that, in my opinion, the Upper Machodoc is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers U. S. A.

J 21.

PRELIMINARY EXAMINATION OF [GREAT] WICOMICO RIVER, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., April 22, 1891.

GENERAL: In compliance with instructions contained in Department letter dated September 20, 1890, I submit the following report of a preliminary examination of Wicomico River, Va.

There are two rivers in Virginia of this name, the Great Wicomico and the Little Wicomico. They both empty into Chesapeake Bay, the former a short distance below and the latter at the mouth of the Potomac. With a view to ascertaining which one was meant in the harbor and river bill, I addressed a letter to Hon. Thos. H. Bayly Browne, Member of Congress from Virginia, at whose instance, I was informed, the order for the examination or survey was inserted in the harbor and river bill. From his reply I infer that the Great Wicomico was meant to be examined. This stream is navigable for vessels drawing 7 to 8 feet of water, as far up as Sampson's Wharf, the present head of steamboat navigation, a distance of about 9 miles from its mouth. It is navigable for vessels drawing 5 feet for a distance of 2½ miles farther.

The river, for the greater part, is wide and deep, and the country along its banks fairly well cultivated, and access to markets easy. It affords excellent facilities for the planting and raising of oysters, and there is a considerable trade in the oyster business. The products of the country are grain, poultry, vegetables, timber, and railroad ties. The amount of each I have not been able to estimate.

The improvement desired is the deepening of the river above Sampson's Wharf, so that vessels of a larger class can go about 2½ miles farther up and load without the necessity for lightering. Such an improvement could be made at an estimated cost of $86,000. I fail to see that any great benefit could result from such an improvement. I am informed by the president of the Maryland Steamboat Company that the amount of business done at Sampson's, the highest point to which steamers go, is barely enough to justify them in going that far. Above this point the only business at the present time is the shipment of railroad ties, cord wood, and ship timber. These are conveyed in light-draft schooners. I invite attention to an examination and survey made by Mr. S. T. Abert in 1883, in respect to the improvement of this portion of the river. Mr. Abert was of the opinion that the river was worthy of improvement. I do not concur in this view of the matter. I do not think the amount of trade at present is sufficient to justify the Government in undertaking the work, and the prospective increase is so limited that I can not recommend it.

In view of the above, I am of the opinion that the Great Wicomico River is not worthy of improvement by the National Government.

Very respectfully, your obedient servant.

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

J 22.

PRELIMINARY EXAMINATION OF CRANE'S CREEK, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., April 22, 1891.

GENERAL: In compliance with instructions contained in Department letter dated September 20, 1890, I submit the following report of a preliminary examination of Crane's Creek, Virginia:

Crane's Creek is a tidal estuary of the Great Wicomico, into which it empties near the mouth of the latter stream. The creek is from 9 to 10 feet deep for a distance of little more than half a mile. The adjacent country is fairly well cultivated, and the waters of the creek would afford good facilities for oyster-planting. At the mouth of the creek there is a bar over which only about 2 feet can be carried at low tide. This bar is formed of sand. The produce of the country tributary consists chiefly of railroad ties, cord wood, and grain, the amount of which is not large, though I can not give the exact figures.

The improvement desired is the cutting of a channel through the bar at the mouth of the creek. This would give an entrance, which is now practically closed, to vessels of greater draft than 2 feet and would develop some trade. The amount, however, would be small, as the deep water of the creek reaches only about half a mile from its mouth. The cost of cutting a channel through the bar, say 150 feet wide by 8 feet deep, would be about $20,000, but whether it would remain open without works of contraction is doubtful.

In view of all the circumstances I am of the opinion that Crane's Creek is not worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers.

J 23.

PRELIMINARY EXAMINATION OF PISCATAWAY CREEK, VIRGINIA.

[Printed in House Ex. Doc. No. 59, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 4, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated October 30, 1890, from Lieut. Col. Peter C. Hains, Corps of Engineers, giving results of preliminary examination of Piscataway Creek, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Hains reports that in his opinion Piscataway Creek is not worthy of improvement by the National Government, and I concur in his opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., October 30, 1890.

GENERAL: In accordance with the instructions contained in Department letter dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Piscataway Creek, Virginia:

Piscataway Creek, Virginia, empties into the Rappahannock River about 3 miles below the town of Tappahannock. After crossing the bar at its mouth it is navigable for vessels drawing about 7 feet for a distance of 5 or 6 miles. The creek is narrow and tortuous, though generally deep. The obstruction to navigation is the bar at its mouth, over which only about 3 feet at low tide can be carried; but as the tide rises and falls about 2 feet, 5 feet or more can be carried over it at high water. The bottom is so soft that vessels can drag their keels through several inches without damage.

The trade on the creek is small, not exceeding in value, as well as could be determined, $50,000 per annum. There is a canning factory on the creek from which about $10,000 worth of goods is said to be shipped annually. The remainder of the trade is chiefly in lumber, cord wood, railroad ties, and grain. It is reported that the lumber business was formerly quite large, about 10,000,000 feet being shipped annually. This has fallen off to about one-tenth that amount. It is thought that the falling off is due more to the fact that the best timber has been cut out of that section of country than to a want of facilities for shipping it.

There is a wharf at Tappahannock where steamers land three times a week, and all light and perishable freight, such as vegetables, etc., from the adjacent country, is shipped from there.

To deepen the entrance to the creek, so that it would be of material advantage to vessels of heavier draft than now enter it, would, in my opinion, cost more than the trade of the creek would justify. To dredge a channel, say 200 feet wide and 7 deep, would cost about $20,000. Such a dredged channel it is believed would not be permanent. It would need redredging from time to time, or the construction of dikes to regulate the flow of water so that the cut would not fill up. Such dikes would cost about $20,000 more, so that the cost of the entire improvement would not be less than about $40,000.

For the reasons given above Piscataway Creek, Virginia, is not, in my opinion, worthy of improvement by the National Government.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

APPENDIX K.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

REPORT OF CAPTAIN G. J. FIEBEGER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. **Harbor of Norfolk and its approaches, Virginia.**
2. **Approach to Norfolk Harbor and the United States Navy-yard at Norfolk, Virginia.**
3. **Hampton Creek and Bar, Virginia.**
4. **Nansemond River, Virginia.**
5. **Chickahominy River, Virginia.**
6. **Appomattox River, Virginia.**
7. **Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina, through Currituck Sound.**
8. **North Landing River, Virginia and North Carolina.**
9. **Currituck Sound, Coanjok Bay, and North River Bar, North Carolina.**

EXAMINATIONS.

10. **Chickahominy River, Virginia, from Holly Landing to Long Bridge.**
11. **Western Branch of Elizabeth River, Virginia.**
12. **Water-way to connect Lynn Haven Bay with Eastern Branch of Elizabeth River, Virginia.**
13. **Nottoway River, Virginia, from mouth of river to Courtland.**
14. **North-West River, North Carolina, up to Moyock.**
15. **West Neck River, to and beyond Dozier's Bridge, Virginia.**

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., July 2, 1891.

GENERAL: I have the honor to transmit herewith the annual reports for the fiscal year ending June 30, 1891, upon the works of river and harbor improvement and examinations in my charge.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

K 1.

IMPROVEMENT OF HARBOR OF NORFOLK AND ITS APPROACHES, VIRGINIA.

The river and harbor act of September 19, 1890, contained the following paragraph:

Improving harbor at Norfolk and its approaches, Virginia: Continuing improvement, $150,000, $50,000 of which shall be expended in improving the approach to the inner harbor and the United States navy-yard at Norfolk, by increasing anchorage between Lambert Point and Fort Norfolk.

The anchorage herein mentioned is not contained in the project adopted in 1885, and therefore is not contemplated in previous estimates.

The estimated cost of this anchorage as given in the report hereunto attached is $150,000; the estimate for the completion of the existing project should therefore be increased by this amount.

A project for the expenditure of the appropriation of September 19, 1890, was submitted to the Chief of Engineers and approved.

In accordance therewith proposals were invited for dredging, and on December 27, 1890, bids were received and opened. All the bids in conformity with the specifications being considered too high, the work was readvertised and a second lot of bids received and opened January 30, 1891. On March 13, 1891, a contract was entered into with the National Dredging Company of Wilmington, Del., to do the work for 10.7 cents per cubic yard.

Work was begun by this company on April 2 and at the close of the fiscal year 273,022 cubic yards had been dredged from the bar at Sewell Point and the channel widened about 100 feet.

Under the existing contract, the channel through Sewell Point Bar will be completed, one-third of the anchorage dredged, and the shoal removed from the mouth of the Eastern Branch.

Future work.—The work of the greatest importance under the existing project is the completion of the anchorage between Lambert Point and Fort Norfolk. Daily complaints are now made of the obstruction to navigation by vessels lying at anchor off Lambert Point coal piers. Next in importance is the completion of the work in the inner harbor near the junction of the Eastern and Southern branches, where the channel is much too narrow to accommodate the passing vessels without great danger of collisions. The estimated cost of the dredging to afford immediate relief to the commerce of this port is—

Anchorage, 666,666 cubic yards, at 15 cents	$100,000
Southern Branch, 75,000 cubic yards, at 15 cents	11,250
Eastern Branch, 183,333 cubic yards, at 15 cents	27,500
Berkley Flats, 348,333 cubic yards, at 15 cents	52,250
	191,000

This amount could be advantageously expended in the fiscal year ending June 30, 1893.

Money statement.

July 1, 1890, balance unexpended	2,003.90
Amount appropriated by act approved September 19, 1890	150,000.00
	152,003.90
June 30, 1891, amount expended during fiscal year	15,719.54
July 1, 1891, balance unexpended	136,284.36
July 1, 1891, amount covered by uncompleted contracts	121,612.00
July 1, 1891, balance available	14,672.36
Amount (estimated) required for completion of existing project	457,744.56
Amount that can profitably be expended in fiscal year ending June 30, 1893	191,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Norfolk Harbor, Virginia, opened December 27, by Lieut. G. J. Fiebeger, Corps of Engineers.

No.	Name and address.	Time.		Price per cubic yard. Dump between sunrise and sunset.	Price per cubic yard. Dump at any time.
		Commence.	Complete.		
1	American Dredging Co., Philadelphia, Pa.	Jan. 15, 1891	June 30, 1891	$0.17	$0.18
2	Morris & Cummings Dredging Co., New York City, N. Y.	Jan. 10, 1891	July 10, 1891	.15½	.12½
3	P. Sanford Ross, Jersey City, N. J.	Jan. 15, 1891	June 30, 1891	.15¼	.13
4	Atlas Dredging Co., Wilmington, Del.	Jan. 10, 1891		.15	.12
5	National Dredging Co., Wilmington, Del.	Feb. 1, 1891			.11

All rejected. Lowest bids not in conformity with specifications, others considered too high.

Abstract of proposals for dredging in Norfolk Harbor, Virginia, received and opened January 30, 1891, by Lieut G. J. Fiebeger, Corps of Engineers.

No.	Name and address.	Time.		Price per cubic yard.
		Commence.	Complete.	
1	P. Sanford Ross, Jersey City, N. J.	Feb. 20, 1891	May 31, 1892	$0.10 8/10
2	Baltimore Dredging Company, Baltimore, Md.	May 1, 1891	May 31, 1892	.12½
3	Morris & Cumings Dredging Company, New York City.	When contract is approved.	May 31, 1892	.10 3/10
4	Atlas Dredging Company, Wilmington, Del.	...do	May 31, 1892	.10 7/10
5	National Dredging Company, Wilmington, Del.	According to specifications.		.11*

* Submits a supplemental bid of 10.7 cents per cubic yard, which bid was accepted by direction of the Secretary of War.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, NORFOLK, VA.,
Collector's Office, April 28, 1891.

SIR: Inclosed please find a statement of imports, exports, number of vessels entered and cleared, with their tonnage, both foreign and coastwise, at this port from January 1, 1890, to January 1, 1891.

Very respectfully,

R. G. BANKS,
Collector.

Capt. G. J. FIEBEGER, U. S. A.

Imports.

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
Salt ......lbs..	6,748,316	$12,774	Ready-made clothing		$71
Cotton ties ......lbs..	1,616,000	29,628	Phosphate ......tons..	375	3,750
Nitrate soda ......lbs..	2,492,565	29,204	Jewelry		2
Wine ......bottles..		150	Lace edging		31
Wine in casks ......galls..	412	213	Miscellaneous		907
Beer ......bottles..		902			
Kainit ......tons..	2,448	16,855	Total		94,487

Exports.

Articles.	Value.	Articles.	Value.
Cotton	$13,992,489	Rosin	$5,483
Coal	451,986	Cattle	71,680
Staves	246,655	Flour	17,755
Lumber	220,285	Dry goods	50
Tobacco	18,216	Factory sweepings	9,859
Corn	10,750	Spokes, etc	5,965
Wheat	16,000	Tallow	444
Blocks	8,645	Bensine	64
Shingles	2,400	Fence	300
Coffee	100	Miscellaneous	980
Bark	16,508		
		Total	15,096,635

Navigation.

Direction.	Vessels cleared.		Vessels entered.	
	No.	*Tons.*	*No.*	*Tons.*
Foreign	397	463,216	81	83,341
Coastwise	1,504	1,546,235	1,169	1,140,625
Total	1,901	2,009,451	1,250	1,223,966

LETTER OF MR. NORMAN BELL, SUPERINTENDENT AND SECRETARY NORFOLK AND PORTSMOUTH COTTON EXCHANGE.

NORFOLK AND PORTSMOUTH COTTON EXCHANGE,
Norfolk, Va., April 11, 1891.

DEAR SIR: I herewith submit statement of the receipts and shipments of cotton at the port of Norfolk for the fiscal year ending December 31, 1890:

	Bales.
Total receipts cotton at Norfolk 12 months ending December 31, 1890	515,548
Stock on hand December 31, 1889	37,713
Exported:	
Great Britain	227,619
France	11,549
Continent	44,924
	284,092
Coastwise ports, overland and inland	210,123
Total shipments	494,215
Stock on hand December 31, 1890	59,046
Total	553,261

On the basis of 488.22 pounds to the bale, which is the average of weight on exports to December 31 from September 1, 1890, the exports and shipments amount to 107,270½ tons.

Trusting this information is what you require, I remain, dear sir,

Yours, very truly,

NORMAN BELL,
Superintendent and Secretary.

Statement of coal delivered at Lambert Point Pier and local at Norfolk, Va., during the year ending March 31, 1891, as cleared by William Lamb & Co., agents.

Steamers:		
Bunkers		398
Cargo and bunkers		28
		426
Barkentines		1
Ocean tugs and barges		540
Schooners		543
Total vessels		1,510
Foreign	tons..	34,055
Steamers, bunkers	do...	115,925
Ocean tugs	do...	15,240
Local	do...	74,924
Coastwise	do...	986,708
Total		1,226,852

Tabular statement of value of exports and imports and number and tonnage of vessels registered at the port of Norfolk, Va.

Years ending January 1—	Foreign vessels.				Coastwise vessels.				Exports.	Imports.
	Entered.		Cleared.		Entered.		Cleared.			
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*		
1883...	64	29,572	135	112,529	1,314	1.248,461	818	1,099,266	$18.201,759	$167,157
1884...	96	69,421	156	110,450	1,257	1,003,920	880	996,062	12,351,672	223,676
1885...	66	70,711	127	102,821	1,330	1,078,484	1,450	1,275,477	14,797,046	128,372
1886...	82	67,168	159	141,913	1.398	1,215,398	1,555	1,334,557	11,646,907	127,391
1887...	73	73,896	208	207,428	1,432	1,261,365	1,719	1,432,016	14,393,337	99,958
1888...	66	59,805	212	234,644	1,344	1,360,683	1,474	1,354,620	12,381,122	99,584
1889...	51	64,975	227	256,351	1,328	1,286,578	1,402	1,290,013	13,865,586	176,253
1890...	70	80,887	288	335,021	996	1,265,470	1,302	1,230,189	12,828,641	166,958
1891...	81	83,341	397	463,216	1,169	1,140,625	1,504	1,546,235	15,096,634	94,487

Approximate amount of freight of all kinds received and shipped by water.

	Tons.
1888	1,914,506
1889	2,243.087
1890	2,384,841

REPORT OF LIEUTENANT G. J. FIEBEGER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., February 26, 1890.

GENERAL: I have the honor to make the following report on the subject matter of a letter from the chairman of Committee on Rivers and Harbors, House of Representatives, United States, referred to me by your indorsement on the 24th instant.

As to the improvement of Norfolk Harbor, the portion between Lambert Point and Fort Norfolk excepted, I have no changes to report. As stated in the Annual Report for 1889, I think the amount recommended by the Chief of Engineers, $100,000, can be advantageously expended during the fiscal year ending June 30, 1891, in improving the approach at Sewell Point and in the inner harbor.

As to "approach between Lambert Point and Fort Norfolk," I have to state that since June 30, 1889, the dredging has been completed, a survey made, and the harbor lines established.

No injurious shoaling of the channel dredged in 1885 and 1887 has been discovered; it is therefore thought that the construction of the dike which forms a part of the present project may be omitted.

The channel is everywhere 700 feet wide and 25 feet deep from Lambert Point to Fort Norfolk, and I would therefore recommend no further work on this project.

The Norfolk and Carolina Railroad pier and warehouses at Pinner Point are nearly finished, and this road will probably be in operation before July.

The Norfolk and Western Railroad has begun the construction of new piers at Lambert Point; the first of these will also be finished this summer.

It is understood that the company intends to make all foreign shipments from these piers instead of from the wharves now in use in the inner harbor.

To accommodate the shipping which will thus be brought into the lower harbor, it has been urged that the present anchorage grounds, which are already crowded by the coal trade, be enlarged.

The commercial value of the harbor would undoubtedly be very much increased thereby, as both naval and merchant vessels now anchor in mid-channel and greatly interfere with the movement of vessels in the harbor.

Should Congress undertake this improvement, I would suggest that the desired anchorage be secured by dredging the area indicated on the accompanying chart.

The total cost of dredging to a depth of 25 feet would be about $150,000; one-half of this could be advantageously expended during the fiscal year ending June 30, 1891.

This additional work would make the total estimated cost of improving Norfolk Harbor $607,744.56. * * *

Very respectfully, your obedient servant,

G. J. FIEBEGER,
First Lieutenant, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

K 2.

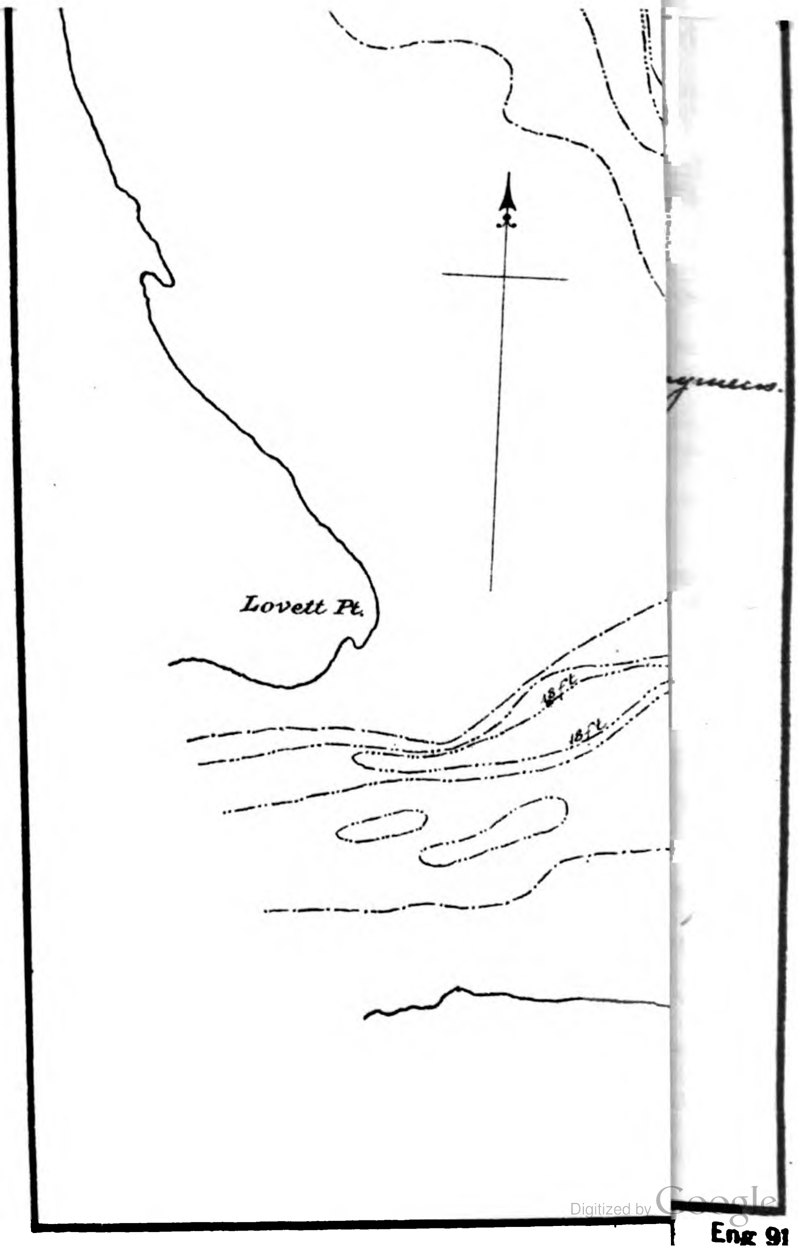
IMPROVEMENT OF APPROACH TO NORFOLK HARBOR AND THE UNITED STATES NAVY-YARD AT NORFOLK, VIRGINIA.

The object of this improvement is to secure a channel 700 feet wide and 25 feet deep at ordinary low water by dredging and the construction of a dike.

The desired channel was secured in July, 1889, since which time no dredging has been done.

Surveys made in August, 1889, and May, 1891, indicate very little, if any, shoaling of the dredged channel; the present condition, as given by these surveys, as well as the condition of the channel before any improvement was undertaken, is shown on the accompanying maps.

It is not probable that the dike will be necessary for the maintenance of the channel. The money estimated for this dike could be more advantageously expended on the removal of the shoal on the east side of the



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channel near Lambert Point, being a continuation of the dredging of 1887 and 1889, as shown on map 2.

For commercial statistics, see report on improvement of harbor of Norfolk and its approaches.

Money statement.

July 1, 1890, balance unexpended	$4,912.73
June 30, 1891, amount expended during fiscal year	4,051.16
July 1, 1891, balance unexpended	861.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	108,000.00

K 3.

IMPROVEMENT OF HAMPTON CREEK AND BAR, VIRGINIA.

This river is a tidal stream which empties into Hampton Roads about 2 miles from Fort Monroe. It is navigable for vessels drawing 11 feet at high water as far as the public wharf, Hampton, about 1 mile from its mouth.

Before 1879 the channel in the river was 60 feet wide and 8 feet deep at low water; over the bar the depth was somewhat less. In 1879 and 1880 the Government dredged a channel 150 feet wide and 9 feet deep as far as the public wharf. In 1889 this channel was examined and found in good condition; it was therefore recommended that the channel be widened to 200 feet in the creek and from 200 to 300 feet over the bar.

The necessary appropriation was made for this work in the river and harbor act of September 19, 1890. A project for its expenditure was accordingly submitted to the Chief of Engineers and received his approval. In accordance therewith a careful survey was made of the river and proposals invited for dredging. On March 20, 1891, a contract was entered into with the Atlas Dredging Company to do the work for 11 cents per cubic yard. This contract is to be begun on or before January 1, 1892, and completed in 4 months.

A map of the last survey showing proposed dredging accompanies this report.

The improvement of this creek receives its importance from the fact that along its banks are the town of Hampton, the Hampton Industrial School, and the National Soldiers' Home. Most of the supplies for these places are received by water.

A daily line of steamers runs between Hampton and Norfolk, and a weekly line between Hampton and Baltimore.

A very full report of the commerce of Hampton is given in the Report of Chief of Engineers for 1889, page 975, since which time there has been no appreciable change.

Money statement.

mount appropriated by act approved September 19, 1890	$10,000.00
une 30, 1891, amount expended during fiscal year	117.16
uly 1, 1891, balance unexpended	9,882.84
uly 1, 1891, amount covered by uncompleted contracts	8,500.00
ly 1, 1891, balance available	1,382.84

*Abstract of proposals for dredging * * * received and opened at noon of March 10, 1891, by Capt. G. J. Fiebeger, Corps of Engineers.*

No.	Name and address of bidder.	Time.		Locality.	Price per cubic yard.
		Commence.	Complete.		
1	Chester T. Caler, Norfolk, Va.	....	2 months....	Hampton Creek and Bar, Va..	$0.12
2	Atlas Dredging Co., Wilmington, Del.	Jan. 1, 1892	Apr. 1, 1892	....do	.11
3	National Dredging Co., Wilmington, Del.	Dec. 1, 1891	Feb. 1, 1892	....do	.12
4	Alabama Dredging and Jetty Co., Mobile, Ala..	Jan. 1, 1892	June 30, 1892	....do	.18

Contract awarded Atlas Dredging Company.

COMMERCIAL STATISTICS.

Approximate amount of freight (annually) of all kinds received and shipped by water, 25,000 tons.

K 4.

IMPROVEMENT OF NANSEMOND RIVER, VIRGINIA.

The object of this improvement is, briefly, to secure a 12-foot low-water channel from Suffolk to Hampton Roads.

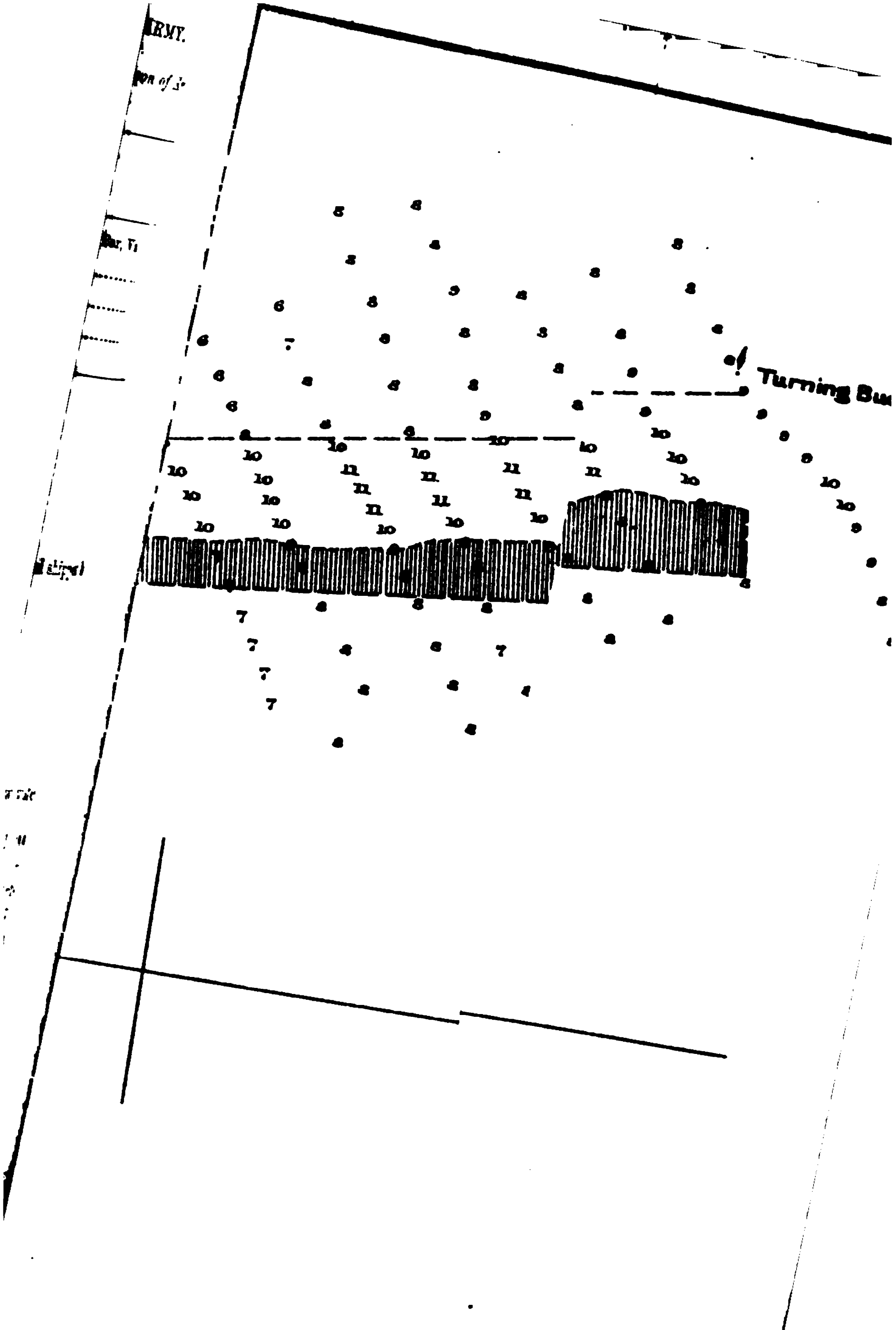
The river and harbor act of September 19, 1890, appropriated $10,000 for this work. A project for its expenditure was submitted to the Chief of Engineers and approved. In accordance therewith proposals were invited for dredging, and on April 4, 1891, a contract was entered into with the Alabama Dredging and Jetty Company, of Mobile, Ala., to do the work for 20 cents per cubic yard. Work under this contract will be carried on during the winter of 1891–'92.

For map of river see Annual Report of the Chief of Engineers for 1887, page 1002.

Money statement.

July 1, 1890, balance unexpended	$1,425.49
Amount appropriated by act approved September 19, 1890	10,000.00
	11,425.49
June 30, 1891, amount expended during fiscal year	9.82
July 1, 1891, balance unexpended	11,415.[illegible]
July 1, 1891, amount covered by uncompleted contracts	9,700.[illegible]
July 1, 1891, balance available	1,715.67
Amount (estimated) required for completion of existing project	132,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	32,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.



To ac Report of 1881

G. J. Lydecker
Capt Corps of Engrs

*Abstract of proposals for dredging * * * received and opened at noon of March 10, 1891, by Capt. G. J. Fiebeger, Corps of Engineers.*

No.	Name and address.	Locality.	Time.		Price per cubic yard.
			Commence.	Complete.	
1	Chester T. Caler, Norfolk, Va.	Nansemond River, Virginia	....	3 months..	*$0.21 †.27½
* * * *		* * *	*	*	*
4	Alabama Dredging and Jetty Co., Mobile, Ala.	Nansemond River, Virginia	Mar. 1, 1892	June 30, 1892	.20
5	H. E. Culpepper, Portsmouth, Va.	......do	Apr, 1, 1891	June 30, 1891	.32½

* Material put ashore. † Material towed away.

Contract awarded Alabama Dredging and Jetty Company (No. 4).

COMMERCIAL STATISTICS.

The shipments on this river are principally farm products, lumber, etc. During the year 1890 these were—

Lumber .... feet..	30,703,475
Cords wood	11,725
Railroad ties	181,582
Laths	311,600
Shingles	391,200
Farm products, etc .... tons..	15,245

Approximate amount of freight of all kinds received and shipped by water.

	Tons.
1888	109,900
1889	217,738
1890	117,836

K 5.

IMPROVEMENT OF CHICKAHOMINY RIVER, VIRGINIA.

This improvement was received from Lieut. Col. Peter C. Hains, Corps of Engineers, October 30, 1890.

The object of this work is to secure a channel 11 to 12 feet deep at high water from Windsor Shades, the head of navigation, to the mouth of the river, a distance of 25 miles.

In January, 1891, an examination was made of all the work hitherto done with a view to determining the permanency of the dredged channels and the portions of the river in most need of improvement.

Very little shoaling was found to have taken place in the channels dredged since 1878; the worst shoals are those near Old Fort, which have a minimum depth of 9 to 10 feet high water and a minimum width of 40 to 50 feet.

A project for the improvement of these shoals by dredging, under the appropriation of September 19, 1890, was submitted to the Chief of Engineers and approved. In accordance therewith proposals were invited and on March 24, 1891, a contract was entered into with Chester T. Caler to do the work for 15½ cents per cubic yard. This dredging is to be completed before the end of the fiscal year ending June 30, 1892.

It is hoped that the small balance, $5,000, which is required to complete this work, may be granted in a single appropriation, as the improvement is urgent.

A map of this river is given in Report of the Chief of Engineers for 1889, page 1018.

Money statement.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	90.98
July 1, 1891, balance unexpended	2,409.02
July 1, 1891, amount covered by uncompleted contracts	2,000.00
July 1, 1891, balance available	409.02
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

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*Abstract of proposals for dredging * * * received and opened at noon of March 10, 1891, by Capt. G. J. Fiebeger, Corps of Engineers.*

No.	Name and address of bidder.	Localities.	Time.		Price per cubic yard.
			Commence.	Complete.	
1	Chester T. Caler, Norfolk, Va	Chickahominy River, Va		30 days	$0.15½
*	* * * *	* * *	* *	* *	* *
4	Alabama Dredging and Jetty Co., Mobile, Ala.	Chickahominy River, Va	June 1, 1892	June 30, 1892	*.15
5	H. E. Culpepper, Portsmouth, Va.	do	April 1, 1891	June 30, 1892	.24

* If three other works are awarded also.

Contract awarded to Chester T. Caler.

COMMERCIAL STATISTICS.

The shipments on this river are principally cord wood and railroad ties. In 1890 these were: Wood, 14,631 cords; railroad ties, 145,517.

Approximate amount of freight of all kinds shipped in 1890, 40,135 tons.

K 6.

IMPROVEMENT OF APPOMATTOX RIVER, VIRGINIA.

The river and harbor act of September 19, 1890, appropriated $15,000 for this improvement. A project for its expenditure was submitted to the Chief of Engineers. In accordance therewith in October cross sections were taken of this river every 100 to 200 feet from Petersburg to Sunken Island, a distance of 7 miles. The map of this survey shows a channel 11 to 12 feet deep from the deep water at Point of Rocks to

Petersburg, obstructed by three shoals. These are below Rushmore Dike, at upper end of Puddledock Cut, and within the city limits along Lieutenant Run wall and Magazine Bend. Over these shoals the depth shown by the map is 9 to 10 feet at high water.

To remove these shoals it was decided:

(1) To rebuild Rushmore dam and thus increase the freshet flow through the main channel of the river.

(2) To construct 18 jetties between Rushmore Dike and the South channel jetties and thus concentrate the freshet action.

(3) To dredge a channel 40 feet wide 12 feet deep through the shoal at the upper end of Puddledock Cut.

(4) To repair the closure dike.

(5) To construct and repair training dikes at Lieutenant Run and Magazine Bend.

During the months of November, December, January, and February, with the Government plant, hired labor, and the dredge belonging to the city of Petersburg, 13,512 cubic yards were removed from the Puddledock Shoal and deposited behind the closure dike, at a cost of 20½ cents per cubic yard.

On January 8, 1891, a contract was made with Winslow Jameson for the construction of the proposed jetties and dikes. Work was begun on the jetties March 11 and continued until March 21, when the death of the contractor caused a suspension of the work. It was resumed on May 11, and continued, except when interrupted by freshets, up to the end of the fiscal year; 18 jetties, having an aggregate length of 2,200 feet, have been completed.

In April and May, Rushmore Dam was entirely rebuilt, and raised to the height of 4 feet above high water, so as to be above ordinary freshets; willows and rushes were planted along its base.

For the relief of commerce, the city of Petersburg has dredged the shoals within the city limits.

There still remain, of the work proposed, the construction and repair of the dikes. This work will be done early in the fiscal year ending June 30, 1892.

Soundings made on June 16, 1891, show a channel 11 to 12 feet deep from Point of Rocks to Petersburg, except at the shoal below Rushmore Dike, where the jetties have not had time to act, and within the city limits, where the dredging has not been completed.

For maps, etc., see Report of the Chief of Engineers for 1889, page 960.

Money statement.

July 1, 1890, balance unexpended	$453.08
Amount appropriated by act approved September 19, 1890	15,000.00
	15,453.08
June 30, 1891, amount expended during fiscal year	4,033.07
July 1, 1891, balance unexpended	11,420.01
July 1, 1891, amount covered by uncompleted contracts	4,221.45
July 1, 1891, balance available	7,198.56
Amount (estimated) required for completion of existing project	15,080.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,080.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for constructing jetties and dikes in Appomattox River, Virginia, opened December 27, 1890, by Lieut. G. J. Fiebeger, Corps of Engineers.

No.	Name and address of bidder.	Time.		Price per linear foot.
		Commence.	Complete.	
1	Simond West, Petersburg, Va*	....	....	75 cents, wattle jetty; $4.50, timber jetty with mattrass protection; 95 cents, Dike A; 80 cents, Dike B.
2	W. Jameson, Berkley, Va† ...	Mar. 1, 1891	June 1, 1891	79 cents, wattle jetty; $3.24, timber jetty with mattrass protection; $1.06, Dike A; 98 cents, Dike B.

* Approximate total, $4,441.25. † Approximate total, 4,221.45.

Contract awarded W. Jameson.

COMMERCIAL STATISTICS.

[Furnished by Mr. W. E. Morrison, port warden.]

Tabular statement of number and tonnage of vessels, and value of freight shipped and received, at Petersburg, Va.

Years ending—	No.	Tonnage.	Value of freights.		
			Shipped.	Received.	Total.
July 1, 1881	645	35,967	$74,724	$412,642	$487,366
1882	917	43,961	79,154	519,209	598,363
1883	980	46,070	181,763	569,876	751,639
1884	924	46,050	196,458	612,472	808,930
1885	893	40,669	230,508	529,786	760,294
1886	953	68,835	192,053	474,250	666,303
1887	836	63,169	104,923	304,425	409,348
1888	599	30,079	143,673	372,112	515,785
1889	595	27,981	182,072	270,031	402,103
Jan. 1, 1890	598	29,229	184,596	323,256	507,852
1891	621	35,219	425,887	280,254	706,141

Approximate amount of freight of all kinds received and shipped by water.

	Tons.
1888	30,626
1889	26,121
1890	21,693

K 7.

IMPROVEMENT OF INLAND WATER ROUTE FROM NORFOLK, VIRGINIA, TO ALBEMARLE SOUND, NORTH CAROLINA, THROUGH CURRITUCK SOUND.

This route, for the improvement of which the river and harbor act of September 19, 1890, contained an item of $10,000, is composed of several water ways, which have been separately under improvement.

The Elizabeth River, 11.9 miles long, was under improvement between 1873 and 1878. At a cost of $40,180 a channel 60 feet wide and 8 feet deep at low water was secured.

The North Landing River, 17 miles long, was under improvement between 1879 and 1887. At a cost of $49,777.34 a channel 80 feet wide and 9 feet deep was secured.

Currituck Sound, Coanjock Bay, and North River Bar, 13½ miles, were under improvement between 1879 and 1890. At a cost of $141,656.16 a channel 80 feet wide and 9 feet deep was secured through the sound, and a channel of the same depth 40 feet wide through the bay and over the bar.

The project adopted for the entire route is a channel 80 feet wide and 9 feet deep at low water, to correspond to that already secured over nine-tenths of the route.

A survey was made of such parts as needed further improvement during December and January, and an estimate made of the cost of completing the project.

This estimate for dredging is as follows:

	Cubic yards.
Elizabeth River:	
Deepening and widening channel from Albemarle and Chesapeake Canal Lock, 2¼ miles	38,000
Removing sharp bends	18,000
Coanjock Bay, widening channel from 40 to 80 feet	73,064
North River, widening channel from Albemarle and Chesapeake Canal to below Beacon 9	26,000
North River Bar, widening channel from 40 to 80 feet	34,000
Total	189,064
At 30 cents per cubic yard this would make	$56,719.20
For removal of sunken logs, etc	3,000.00
	$59,719.20
15 per cent. for engineering and contingencies	8,957.88
	68,677.08

A project for the expenditure of the amount ($10,000) contained in the river and harbor act of September 19, 1890, having been submitted to the Chief of Engineers and approved, in accordance therewith $342.66 was devoted to the removal of sunken logs from the Elizabeth River. This work was done by hired labor and a hoister obtained in open market. On February 9, 1891, proposals were invited for dredging, and on March 24, 1891, a contract was entered into with Chester T. Caler, of Norfolk, Va., to do such work in Elizabeth and North Rivers at 24¾ cents per cubic yard.

This work is to be completed before June 30, 1892.

For map see Annual Report of Chief of Engineers for 1889, page 962.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	519.04
July 1, 1891, balance unexpended	9,480.96
July 1, 1891, amount covered by uncompleted contracts	8,000.00
July 1, 1891, balance available	1,480.96
Amount (estimated) required for completion of existing project	58,677.08
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

*Abstract of proposals for dredging * * * received and opened at noon of March 10, 1891, by Capt. G. J. Fiebeger, Corps of Engineers.*

No.	Name and address of bidder.	Locality.	Time.		Price per cubic yard
			Commence.	Complete.	
1	Chester T. Caler, Norfolk, Va.	Inland water route, etc	....	4 months	$0.24¾
	* * * *	* * *	* *	* *	* *
4	Alabama Dredging and Jetty Company, Mobile, Ala.	Inland water route, etc	May 1, 1892	June 30, 1892	.25
	* * * *	* * *	* *	* *	* *
5	H. E. Culpepper, Portsmouth, Va.	Inland water route, etc	Mar. 1, 1892	June 30, 1892	.29

Contract awarded Chester T. Caler.

COMMERCIAL STATISTICS.

[From records of Albemarle and Chesapeake Canal Company.]

Number, class, and tonnage of vessels passing through the inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina.

Year ending—	Steamers.	Schooners.	Barges.	Lighters.	Sloops.	Rafts.	Tonnage.
June 30, 1885	2,976	1,059	623	133	204	181	....
1886	3,271	1,082	549	55	178	244	336,737
1887	3,369	1,216	568	49	181	297	358,111
1888	3,864	1,362	361	44	265	378	435,745
1889	4,065	1,539	683	82	358	352	445,237
Jan. 1, 1890	4,169	1,699	878	67	446	335	454,950
1891	4,068	1,817	1,000	113	394	350	455,442

Approximate amount of all kinds of freight passing through this route.

	Tons.
1888	335,758
1889	372,617
1890	403,111

K 8.

IMPROVEMENT OF NORTH LANDING RIVER, VIRGINIA AND NORTH CAROLINA.

The object of this improvement is to secure a channel 9 feet deep and 80 feet wide from North Landing Bridge to Ferraby Island, Currituck Sound.

The project was completed June 30, 1884, since which time the operations have consisted in removing logs abandoned by rafts. These were last removed between December 1, 1889, and January 4, 1890, since which time no work has been required. It is probable that some dredging will be necessary from time to time to remove shoals caused by vessels grounding outside of the channel.

Future work.—The only operations contemplated for the present are removal of obstructions. The balance on hand will suffice, and no further appropriation is necessary.

This river forms part of the inland water route from Norfolk to Albemarle Sound.

For map, see Annual Report of the Chief of Engineers for 1889, page 962.

The commerce on this river is given under the "Inland Water Route" report.

Money statement.

July 1, 1890, balance unexpended	$2,665.31
July 1, 1891, balance unexpended	2,665.31

K 9.

IMPROVEMENT OF CURRITUCK SOUND, COANJOK BAY AND NORTH RIVER BAR, NORTH CAROLINA.

These waters form part of the inland water route from Norfolk, Va., to Albemarle Sound, North Carolina.

An examination was made of the channel through Coanjok Bay and North River during the months of December, 1890, and January, 1891. The channels hitherto dredged were found in good condition, but only half as wide as proposed in the project. On account of the want of funds no other work was done. The small balance of the appropriation was expended on this examination, care of property, etc; future work will be carried on under the appropriation for "improving inland water route." (See report of that improvement.)

A map of these waters is given in the Report of the Chief of Engineers for 1889, page 962.

The commercial statistics are given under the "Inland Water Route."

Money statement.

July 1, 1890, balance unexpended	$843.84
June 30, 1891, amount expended during fiscal year	843.84

K 10.

PRELIMINARY EXAMINATION OF CHICKAHOMINY RIVER, VIRGINIA, FROM HOLLY LANDING TO LONG BRIDGE.

[Printed in House Ex. Doc. No. 217, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 26, 1891.

SIR: I have the honor to submit the accompanying copy of report dated January 23, 1891, by Lieut. G. J. Fiebeger, Corps of Engineers, giving results of preliminary examination of "Chickahominy River, from Holly Landing to Long Bridge," Va., made to comply with provisions of river and harbor act of September 19, 1890.

It is the opinion of Lieutenant Fiebeger and of the Division Engineer, Col. W. P. Craighill, Corps of Engineers, that this locality is not worthy of improvement, and I concur in their views.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT G. J. FIEBEGER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 23, 1891.

GENERAL: I have the honor to submit the following report* of an examination of "Chickahominy River, from Holly Landing to Long Bridge."

The river and harbor act of August 11, 1888, called for an examination of this river, and a report of same was submitted by Mr. S. T. Abert, United States agent. This report is given in Executive Document No. 41, Fifty-first Congress, first session, and in the Report of Chief of Engineers for 1890, Appendix L.

This report states that—

> Between Long Bridge and Forge Bridge (Providence Forge), a distance of 10 miles, the river may be generally described as a cypress swamp from one-half to 1 mile in width, intersected by a channel from 30 to 80 feet in width, which is crossed on the Mechanicsville road by a causeway and six bridges. This swamp is a tangle of bogs not favorably known to the Army during the late war. It is not proposed to improve this part of the river.

From Forge Bridges to Holly Landing, a distance of three-quarters of a mile, was also considered unworthy of improvement.

While engaged in making an examination of the channels dredged near Windsor Shades and Binns Bar, Assistant Engineer J. P. White was directed to again examine the river between Long Bridge and Holly Landing and obtain such additional data as would show the object of proposed improvement.

His report, which is hereunto appended, indicates that the object of the improvement is drainage and not navigation. I therefore concur in the opinion expressed in the report of Mr. S. T. Abert that the Chickahominy River from Holly Landing to Long Bridge is not worthy of improvement.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
First Lieutenant, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 24, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons given in the report of the local engineer and attached papers, and from personal knowledge of my own, it is my opinion that the Chickahominy River from Holly Landing to Long Bridge, Va., is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. J. P. WHITE, ASSISTANT ENGINEER.

NORFOLK, VA., *January 16, 1891.*

DEAR SIR: I have the honor to submit the following report of an examination of the Chickahominy River from Holly Landing to the Long Bridge.

The examination was made according to your instructions, January 7, 1891.

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*Map not reprinted.

Description.—An attempt was made to traverse the river in a small rowboat, but it was found to be so obstructed by logs, etc., that it was impossible to do so, although the water was 3 feet above its ordinary summer level. The banks being overflowed for a distance of a half mile or more, it was impossible to approach the channel except where crossed by the various roads and the Chesapeake and Ohio Railway. All these lines of communication cross on bridges without draws.

At Long Bridge the stream is 60 feet wide, and has a channel 8 feet deep; at the Chesapeake and Ohio Railroad Bridge, about a mile downstream, it divides into four parts, the best of which is about 40 feet wide and 5 feet deep; at Mount Castle, 5 miles below the Chesapeake and Ohio Bridge it is 65 feet wide and 12 feet deep; at Providence Forge, called 6 miles from Mount Castle, the river has taken the course of an old canal, which is 45 feet wide and 7 feet deep at this point, where the river proper is only 25 feet wide and 3½ feet deep; at Holly Landing, three-fourths of a mile below Providence Forge, the river and canal unite and give sufficient width and depth for a "lighter trade," which is carried on between this point and Windsor Shades.

Object of improvement.—From the inhabitants most interested I learned that the object of improvement was to drain the surrounding country and swamp; none of them seemed to think that there would be any commerce on the stream. I was told that parties at one time undertook to clean out the river for the lumber in the swamp, but found it unprofitable work.

Present means of transportation.—The Chesapeake and Ohio Railroad from Richmond to Newport News, Va., passes within one-half mile of Long Bridge and 1¼ miles of Holly Landing. The distance by rail is 6 miles; by the river 12. The Chickahominy River itself has a channel 8 feet deep at low water and 11 at high tide—due to Government improvement—from Windsor Shades, 4¼ miles below Holly Landing, to its mouth.

As a drain, clearing the river would no doubt be a great benefit to the surrounding country, but as a means of transportation the cost would far outweigh the little good to be derived.

Very respectfully, your obedient servant,

J. P. White,
Assistant Engineer.

Lieut. G. J. Fiebeger,
Corps of Engineers, U. S. A.

K 11.

PRELIMINARY EXAMINATION OF THE WESTERN BRANCH OF ELIZABETH RIVER, VIRGINIA.

[Printed in House Ex. Doc. No. 88, Fifty-first Congress, second session.]

Office of the Chief of Engineers,
United States Army,
Washington, D. C., December 10, 1890.

Sir: I have the honor to submit herewith the accompanying copy of report dated December 4, 1890, from Lieut. G. J. Fiebeger, Corps of Engineers, giving results of preliminary examination of Western Branch of Elizabeth River, Virginia, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant Fiebeger does not consider that the present or prospective needs of commerce demand any immediate improvement, and therefore he reports the stream as not worthy. Because of the facts and reasons stated in this report, and of his own knowledge of this locality, Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, also gives his opinion that the river is suitable to the present needs of commerce, and therefore in the sense of the river and harbor law is not now worthy of improvement. I concur in the views of these officers.

Very respectfully, your obedient servant,

Thos. Lincoln Casey,
Brig. Gen., Chief of Engineers.

Hon. Redfield Proctor,
Secretary of War.

REPORT OF LIEUTENANT G. J. FIEBEGER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., December 4, 1890.

GENERAL: I have the honor to submit the following report, with a map,* of a personal examination of the Western Branch of Elizabeth River, Virginia.

The map was compiled from the U. S. Coast Survey chart of the river and the Norfolk County map. The examination of the channel consisted in a line of soundings to determine whether there had been any alterations since 1873, the date of the chart.

The Western Branch is a tidal stream about 9 miles long, and empties into Norfolk Harbor 2 miles below the junction of the Eastern and Southern branches.

The following table gives the navigable depth of the river from its mouth at ordinary low and high tide:

	Low tide.	High tide.
For a distance from mouth of—	*Feet.*	*Feet.*
2¾ miles	13	15.8
5 miles	8	10.8
6 miles	6	8.8
6½ miles	5	7.8
9 miles	1	3.8

On account of its short length, the depth at ordinary high tide determines the limits of its navigation, for loaded vessels would ordinarily come down at that stage of the tide.

Between 2½ and 5½ miles from its mouth the river is crossed by four pile bridges with draws; the lower two will pass a boat of 40 feet beam and the upper two of 29 feet beam.

The country through which this streams flows is very fertile. Fine truck farms line its banks for a distance of about 7 miles. The bed of the stream on either side of the channel for the same distance is planted with oysters.

The truck and oysters are brought to Norfolk ordinarily in small sloops and schooners drawing when loaded about 4 to 6 feet. There are also three railroads and two shell roads traversing the country bordering on this stream. Two of the former and the latter cross the river at the bridges mentioned. In addition to the small trucking boats, schooners drawing from 7 to 10 feet carry empty barrels and fertilizer to the different farms along the river.

There is no other commerce above the lowest bridge. The Norfolk and Carolina Railroad has a wharf near its crossing, but at present all shipments are made from its pier at Pinner Point, a few miles below, where the channel has a depth of over 25 feet.

Near the mouth of the river at West Norfolk are the piers of the Atlantic and Danville Railroad. Large quantities of wood and lumber are shipped from this point. The vessels engaged in this trade are two and three masted schooners, drawing from 10 to 12 feet loaded.

In order to learn what navigation was desired on this river by those interested, letters were written to the general managers of the Norfolk and Carolina and Atlantic and Danville Railroads asking their views on this subject. In reply the letter herewith appended was kindly sent me by the former. No reply being received from the latter, I assume that the present navigation suffices for the needs of the shipments of the Atlantic and Danville Railroad from West Norfolk. The masters of trucking vessels informed me that there was sufficient depth in the river; the channel was, however, a little narrow in places for sailing vessels.

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* Not printed.

Should commerce demand it, freight steamers of 300 to 400 tonnage, similar to those which now navigate the "inland water route between Norfolk and Albemarle Sound," could be used to bring the truck, etc., from the Western Branch to Norfolk.

It is probable that after the water fronts of the Elizabeth River at Norfolk, Portsmouth, and Berkley are occupied by wharves and piers it will be necessary for the future growth of the harbor to develop the water front of this river, and a wider and deeper channel will be required. When that time comes this improvement should be undertaken, but I do not consider that the present or prospective needs of commerce demand any immediate improvement. I would therefore report the Western Branch of Elizabeth River not worthy of improvement.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
First Lieutenant, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 8, 1890.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report within of December 4, 1890, of the local engineer, and my own knowledge of the Western Branch of Elizabeth River, Virginia, it is my opinion that the river does not need improvement for the present wants of commerce, and therefore, in the sense of the river and harbor law, it is not now worthy of improvement.

If the commerce of Norfolk continues to increase in the future as it has in the recent past, this stream will need improvement, and therefore, in the sense of the river and harbor law, taking into account the prospective needs of commerce, it is expected that it will later be worthy of improvement.

No further survey is now required, and no appropriation by the United States for the river is necessary.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

LETTER FROM GENERAL MANAGER OF NORFOLK AND CAROLINA RAILROAD COMPANY.

NORFOLK, VA., *November 6, 1890.*

DEAR SIR: Replying to your favor of November 1, relative to the business on the Western Branch of the Elizabeth River, we have a wharf located at our crossing of the Western Branch, which is about 5 miles up the river. The depth of water at the wharf is about 18 feet, but we have not been able to do any considerable amount of business at this wharf, as vessels drawing over 8 or 9 feet can not get up to it on account of the bar at the mouth of the river and another at the draw of the county road bridge.

There are several points along the river from our bridge to its mouth that would make valuable manufacturing sites were the bar removed, so that vessels could get up. Our road, running about parallel to the river, could put switches in to the manufacturing sites.

Yours truly,

G. M. SERPELL, *General Manager.*

Lieut. G. J. FIEBEGER,
Corps of Engineers.

K 12.

PRELIMINARY EXAMINATION OF WATER-WAY TO CONNECT LYNN HAVEN BAY WITH EASTERN BRANCH OF ELIZABETH RIVER, VIRGINIA.

[Printed in House Ex. Doc. No. 48, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 4, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 24, 1890, from Lieut. G. J. Fiebeger, Corps of Engineers, giving results of the preliminary examination for "water-way to connect Lynn Haven Bay with eastern branch of Elizabeth River, Virginia," made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant Fiebeger does not consider the water way as worthy of improvement. Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, is of the same opinion in view of the facts and reasons stated and the present and prospective demands of commerce.

The views of these officers are concurred in by this office.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT G. J. FIEBEGER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., November 24, 1890.

GENERAL: I have the honor to submit the following report with maps of a preliminary examination of a "water way to connect Lynn Haven Bay with eastern branch of Elizabeth River, Virginia."

The object of this water-way is to give continuous water transportation to Norfolk, Va., from Lynn Haven, Broad, and Linkhorn bays, without passing around through Hampton Roads. (See map A.)*

The difference in distance from Lynn Haven Inlet is about 10½ miles.

A survey of the bays mentioned was made in 1879–'80 under the direction of the late Capt. C. B. Phillips, Corps of Engineers, U. S.

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* Not printed.

Army, whose report is given in the report of the Chief of Engineers for 1880, Appendix I, and a copy attached hereunto.

The map of that survey was used in compiling map B.*

Navigation.—From this report and map it will be seen that the present navigation at mean low tide of the western branch of Lynn Haven Bay is confined to boats drawing 2½ feet, to eastern branch to boats drawing 1 and 2 feet, and that no boats drawing over 1 foot can pass from these into Broad and Linkhorn bays. The rise of the tide in Lynn Haven Bay is 1.2 feet, and in the other waters almost nothing.

A personal examination made in a rowboat from near the terminal point of the survey of 1879-'80 to the head of navigation at Pembroke Station indicated that the maximum draft of a boat able to navigate this part of the bay at low tide is 2 feet. This navigation is obstructed by three bridges without draws, one foot and two road bridges.

Probably the best location of the proposed water-way is that of the old Lynn Haven and Kempsville Canal.

No very definite information could be obtained of this work; I was informed that it was begun between 1850 and 1860 by a company consisting principally of planters living in the neighborhood of Lynn Haven Bay and Kempsville. About the beginning of the civil war, work was stopped and never again resumed.

The portion between Lynn Haven Bay and the eastern branch, 2¼ miles, is at present a ditch varying in width from 30 to 50 feet, whose bottom is about 3 or 4 feet below the country through which it passes, probably 5 or 6 feet above the level of mean low tide at its highest point. It is entirely overgrown with trees and brush, here and there filled with water, and is crossed by several roads and one railroad on embankments. The lower end, 1½ miles, which was cut for the purpose of straightening the course of the eastern branch of the Elizabeth River, has a navigable depth of probably 2 feet at low tide and 5 feet at high tide from its mouth to Kempsville; its width is ordinarily 15 feet. At Kempsville it is crossed by a road bridge without draw of about 10 feet span and above this is so overgrown as to be almost impassable.

The Eastern Branch of the Elizabeth has a low-water navigation of about 3 feet from the mouth of the canal to Broad Creek and from there to Norfolk 13 feet. This is probably increased by 3 feet at high tide.

The only boats now navigating the waters of Lynn Haven, Broad, and Linkhorn bays are small rowboats drawing about 1 foot, used in fishing and catching oysters. Sloops and wood scows navigate the Eastern Branch of the Elizabeth River as far as Kempsville, and during the trucking season a small flat-bottom steamer runs nearly there.

Character of country and products.—The country, like that around Norfolk, is quite productive and many good trucking farms are found in this region. Its principal shipments, however, are the fish caught along the south shore of Chesapeake Bay and the oysters raised in Lynn Haven Bay. There is still some valuable timber in the swamps around Broad and Linkhorn bays. The country around Lynn Haven Bay is well settled; to the east of this sparsely, and the region known as "the desert," north of Broad Bay, is almost uninhabited. No estimate could be obtained of the annual production of this region.

Present means of transportation.—Nearly everything taken to Norfolk from the country west of Lynn Haven Bay is taken in wagons and carts. The roads are good, two of them being shelled turnpikes as far as Kempsville and Kempsville Station crossroads. East of this, the products are carried in wagons to the stations of the Virginia Beach Railroad and shipped by rail.

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*Not printed.

The lightest draft steamer now engaged in bringing freight to this port from the surrounding country has a draft of 3 feet, is 89 feet long, 9 feet wide, and has a tonnage of 28. As such a vessel could not navigate the upper end of Lynn Haven Bay at low water, it is not probable that any commerce would be diverted from the present lines of transportation to the proposed water way unless the improvement was continued through the various rivers and bays until a continuous low-water navigation of at least 5 feet was secured.

I do not consider such an improvement warranted by the present or prospective needs of commerce, and would therefore report that in my opinion the "water way to connect Lynn Haven Bay with Eastern Branch of Elizabeth River, Virginia," is "not worthy of improvement."

I will state in conclusion that this opinion coincides with that of such of the inhabitants of this region as I had the pleasure of meeting while making this examination.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
First Lieut., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division).

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 26, 1890.

Respectfully submitted to the Chief of Engineers.

In my opinion a water way to connect Lynn Haven Bay with Eastern Branch of Elizabeth River, Virginia, is not worthy of improvement, and the facts and reasons therefor are those given by the local engineer in his report of November 24, 1890, and including the present and prospective demands of commerce.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers,
Division Engineer.

REPORT OF CAPT. C. B. PHILLIPS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., February 21, 1880.

GENERAL: The river and harbor act of March 3, 1879, provided for an examination or survey of the following-named bays in the southeastern part of Virginia, viz: Lynn Haven, Link Horn, and Broad.

These surveys having been assigned to my charge, I placed the field work in the hands of Mr. F. W. Frost, assistant engineer, who organized a party and conducted the work during the months of November and December last. The results of the surveys have since been plotted, and Mr. Frost's report upon same, together with a map on a scale of $\frac{1}{12000}$, exhibiting the three bays in question, is hereby respectfully submitted.*

The three bays communicate with each other and find a passage to Chesapeake Bay through Lynn Haven Inlet, which is at a point about 5 miles distant from Cape Henry. The bays are located in the collection district of Norfolk and Portsmouth,

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*Not printed.

Va. These bays (particularly Lynn Haven) are noted for their fine oysters, and their cultivation forms the principal occupation of the inhabitants in the vicinity.

Excellent pine timber grows in the neighborhood, a considerable quantity of which is shipped yearly, and some fine farming land is also to be found.

The timber is mostly taken to the Chesapeake in the form of rafts, but otherwise the products of the vicinity are mainly transported by land across to the city of Norfolk. It is not probable that any improvement in the navigation of these bays would divert much of this land traffic and cause it to seek communication by water.

At the bar of Lynn Haven Inlet we find but 2 feet of water at an ordinary low stage. It would be useless to attempt any improvement of these bays unless the project should also contemplate the removal of this bar and the maintenance of a channel across it, which would be extremely costly, and, in my opinion, the outlay which would be required to accomplish this would not be warranted by either the present or prospective wants of commerce. I therefore submit no estimates for improvements.

It has been suggested that these bays might be available as links in a line of water communication between Chesapeake Bay and the sounds of North Carolina.

Such a route appears to me a practicable one, but as it could in no sense be called a route "leading from the harbor of Norfolk," I was unable to turn my attention to it in connection with my late canal surveys.

Should the General Government deem it desirable to investigate the merits of this proposed route, a line of about 50 miles in length would have to be carefully surveyed in order to connect the southern limit of these surveys with the deep water of Albemarle Sound.

The accompanying map and field notes would be of assistance in preparing estimates of the cost of such a route. In conclusion, I desire to say that I am indebted to Mr. Frost and to his entire party for the energy and faithfulness displayed by them during the execution of the above surveys, both in the field and office.

I am, general, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. F. W. FROST, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., February 17, 1880.

CAPTAIN: I have the honor to submit the following report of the surveys of Lynn Haven, Broad, and Link Horn bays, made in obedience to your verbal orders in the months of November and December, 1879.

These surveys were commenced on November 12, and the field party, although acting under my directions, was for the most of the time under the immediate supervision of Mr. J. P. Darling during my absence on other important work.

These bays are located in Princess Ann County, Va., and communicate with Chesapeake Bay through Lynn Haven Inlet, which is 4.4 miles west of and 1.2 miles south of Cape Henry light-house.

The waters immediately outside of the inlet are known as Lynn Haven Roads, and those within as Lynn Haven River, Long Creek, Broad, and Link Horn bays.

The appropriation act calls for the survey of Lynn Haven Bay, evidently meaning that body of water which has always been called Lynn Haven River, and we have so designated it upon the map accompanying this report.

Conduct of the Survey.—An initial base line of 814 feet was located at Inlet Point, and from this a system of triangulation was carried over Lynn Haven River, and the greater portion of its two branches, the eastern and western, continuing up the former branch to a point 4¼ miles from the inlet and 1½ miles from "London Bridge," and up the latter branch to a point 4 miles from the inlet, the distances given being measured on the channel line.

From the established transit stations numerous sounding points were located and soundings were taken in the usual manner, and sufficiently near together so as to show the configuration of the river bed. From the base at Inlet Point a line was run upon the northern bank of Long Creek a distance of 3.14 miles, and a connection made with the triangulation of Broad and Link Horn bays. The survey of the former bay was complete, and so much of the latter as lies between the Narrows and Wilkin's Bridge.

These surveys occupied exactly 6 weeks' time, in which 127 transit stations were located and some 8,000 soundings were taken. Owing to the limited amount of money apportioned for the work, it was impossible to obtain the topographical features in detail, more attention having been given to the hydrography.

Submitted with this report is a general map on a scale of $\frac{1}{12000}$, showing the outlines and connections of the several bays reduced to a mean low-water stage.

DESCRIPTION OF THE BAYS IN DETAIL.

Lynn Haven River or Bay.—The entrance to Lynn Haven River or Bay is known as "The Inlet." This has at present a width of 1,750 feet, or about the same as shown on the Coast Survey chart published in 1863. From Inlet Point, on the eastern side, sand flats extend nearly halfway across the inlet. These are wholly exposed at a low-water stage. The entrance channel is on the western side, just off "Stump Hall Point." Over the outside bar 2 feet of water can be carried at a low tide.

We learn from the inhabitants in this locality that the present inlet was originally an artificial opening, constructed many years ago, for the passage of small boats, by one Keeling, and this has been increased to its present size by the action of the tides and by wind currents.

The original inlet communicated with Chesapeake Bay some distance west of the present one, and entered the river in the vicinity of Pleasure House Bay.

At Trading Point the river divides into the Eastern and Western branches, the former of which is wider and longer, but more shallow, than the latter. The shore lines of both branches are very irregular, forming numerous coves. The banks in many places are 20 feet above the water surface, and many good farms are to be found.

Stump Hall Point, on the western side of the inlet, is taken as the initial point, from which all distances are estimated. Via the channel line to the terminal point of the survey on the Eastern Branch the distance is 4¼ miles; 1¼ miles farther on is London Bridge. The river here is about 100 feet in width.

Throughout 4 miles of this section 2 feet may be carried, and over the remaining portion about 1 foot. The entrance to the Eastern Branch (during low tides) is via Keeling's drain, a channel of about 2,000 feet in length and 100 feet in width.

The survey of the Western Branch terminates 4 miles from the inlet (via the channel line). From Stump Hall Point to deep water off Keeling's yellow bank there are properly two channels, both of which are about the same as regards depth and distance.

The channel most commonly used crosses the river from just below Stump Hall to Inlet Point. Over this 2 feet can be carried at a mean low-water stage.

The second channel follows the western bank to Black March Point, then crosses the river and unites with the first channel 500 feet north of Keeling's drain. The channel now continues within the 4-foot contour to the 1¼-mile point just off the Eastern Branch, where a shoal occurs over which only 2½ feet of water can be carried. From Church Point No. 1 near the second mile the channel lies wholly within the 4-foot contour, which is continuous to the 4-mile point, the terminal point of the survey.

We may say that the Western Branch is navigable for vessels of 2½ feet draft at mean low water.

During the time of survey a tide gauge was kept at Witch Duck Point. The mean rise and fall of the ordinary tides was found to be 1.2 feet, but the northerly winds sometimes cause a rise of 4 and 5 feet.

Some of the principal points on this branch are Inlet, Stump Hall, Trading, Church, and Witch Duck. The principal farms are Barton's and Garrison's, upon the western side. There is also some cultivated land in the vicinity of Witch Duck Point.

As an evidence of the effects of the tidal and wind currents upon the shore we will state that Church and Trading points are now 920 feet apart, while formerly they approached within a few feet of each other.

The celebrated Lynn Haven oyster is grown in the numerous coves of both the Eastern and Western branches, and oystering is the principal occupation of settlers in this locality.

Long Creek and Broad Bay.—Long Creek has a general direction from west to east, and connects Lynn Haven River with Broad Bay, leaving the former on the south side of Inlet Point and uniting with the latter near the central point of its northern side.

The average width is 150 feet; length, 3.14 miles; the characteristic sounding is 3 feet, but numerous bars occur, and at the eastern and western extremities shoals exist over which only 1 foot can be carried.

There is a strong tidal current throughout the creek, and the ebb and flow usually last one hour later than at the inlet.

Broad Bay is the central one of three bays, and is very unlike either Link Horn or Lynn Haven in appearance, being quite regular in outline and nearly elliptical in shape. It is about 2½ miles in length, with a breadth of 4,300 feet just across from the entrance of Long Creek.

The 9-foot contour follows nearly parallel to the shore line, and embraces about one-half the area of the bay; within this curve the soundings are very uniform, ranging from 9 to 10¼ feet. Between the 9-foot curve and the shore in many places the soundings change abruptly from 9 to 2 feet.

The ordinary rise and fall of the tide in this bay is about .04 of a foot. Westerly winds increase and easterly winds decrease the water level.

Just beyond the northern shore of the bay, and extending towards Cape Henry, is a large tract of land known as "the desert." Upon the southern shore there is a large area of cultivated land. Large quantities of the native oysters found in this bay are annually caught and transplanted in Lynn Haven River.

Link Horn Bay.—This communicates with Broad Bay through a crooked and shallow channel of 1,000 feet in length, called "The Narrows." The general character of this bay bears a striking resemblance to Lynn Haven River, being irregular in outline, with numerous coves upon either side. At 1¼ miles from The Narrows the bay divides into two branches, the eastern and western. The latter is the principal one and coincides in direction with the main body of the bay, being nearly due north and south. The distance on the channel line from The Narrows to Wilkins Bridge is 3 miles, and the total distance of the latter point from Lynn Haven Inlet is 8.59 miles.

Throughout the greater portion of the bay the characteristic sounding is 12 feet, and 10 feet can be carried to a point 2¼ miles from the entrance to The Narrows.

The western branch of this bay (the one surveyed) has a general width of from 1,000 to 1,500 feet, but in the vicinity of Wilkins Bridge the width decreases to 75 feet, with a depth of only 3 feet.

Wilkin's Bridge, the terminal point of the survey, is about 1¾ miles distant from a point on the Atlantic coast that is nearly 6 miles south of Cape Henry Light.

There are but few inhabitants in the vicinity of Link Horn Bay, and only a small amount of cultivated land.

Excellent pine timber is to be found upon the shores of either branch, a small amount of which is annually cut and rafted through the several bays and Long Creek to Lynn Haven Inlet, and thence towed up the Chesapeake Bay.

While in the field we endeavored to learn from the inhabitants in the vicinity of these bays what improvements, if any, of these waters might be desired by them. Some suggested the necessity of constructing a canal connecting the Chesapeake Bay at Lynn Haven Inlet with Currituck Sound, and this via the Eastern Branch of Lynn Haven River. Others wanted a bridge across the Western Branch of Lynn Haven River, while some of the inhabitants in the vicinity of Broad Bay stated that it was proposed to erect a hotel for a summer watering place at a point known as "The Hollies," not far from Raineys Pond, which connects with Link Horn Bay, and the parties interested in this project desired the improvement of the present channel connecting Raineys Pond with Lynn Haven Inlet.

If the canal project previously mentioned was, as it seems probable, the principal reason for which the survey of these bays was desired, further surveys will be required, for which no appropriation has been made.

The information obtained by these surveys will become of value in the event of any surveys for a canal connecting with them. No estimates for their improvements are submitted with this report.

Very respectfully, your obedient servant,

F. W. FROST.

Capt. CHARLES B. PHILLIPS,
Corps of Engineers, U. S. A.

K 13.

PRELIMINARY EXAMINATION OF NOTTOWAY RIVER, FROM MOUTH OF RIVER TO COURTLAND, VIRGINIA.

[Printed in House Ex. Doc. 87, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 10, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated December 3, 1890, from Lieut. G. J. Fiebeger, Corps of Engineers, giving results of preliminary examination of Nottoway

River, Virginia, from mouth of river to Courtland, made to comply with provisions of the river and harbor act approved September 19, 1890.

Following an examination in November and December, 1878, appropriations were made for the Nottoway in 1880 and 1881. Operations were suspended in 1882. In 1887 it was reported that the proposed improvement should not be completed.

Lieutenant Fiebeger reports that it is not probable that there would be any traffic on this river even if improved, and therefore does not consider it as worthy of improvement. The river is considered not worthy of improvement by Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, because of the facts and reasons set forth in the accompanying report. I concur in the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT G. J. FIEBEGER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., December 3, 1890.

GENERAL: I have the honor to submit the following report, with maps,* of an examination of the Nottoway River, Virginia.

This river has been under improvement before, and the following is a brief account of past work:

The river and harbor act of June 18, 1878, provided for an examination or survey of this river. The examination and partial survey were made in November and December, 1878, under the direction of the late Capt. Chas. B. Phillips, Corps of Engineers, whose report is given in that of the Chief of Engineers for 1879, Appendix H, pages 719–723, and a copy hereunto appended. Should the improvement of this river be undertaken, Captain Phillips recommended that the work be confined to the removal of obstructions without, dredging, giving a channel 7 to 8 feet deep for a distance of 15 miles from its mouth, and above that point a channel 2 to 3 feet deep at its lowest stage for a distance of 50 miles from its mouth.

The estimated cost of this work was $9,000.

Two appropriations were made for the river, $5,000 in 1880 and $2,000 in 1881.

Between August, 1881, and February, 1882, the river was cleared of obstructions from its mouth to a point about midway between Courtland and Delaware Station, and the overhanging trees were removed for a distance of 33½ miles. The work was temporarily stopped by freshets in the river.

In his annual report for 1883, Capt. James Mercur, Corps of Engineers, states:

> An examination made since operations have ceased shows that owing to the loose manner in which logs and timber are rafted, the river above the Seaboard and Roanoke Railroad Bridge is in little, if any, better navigable condition than at the commencement of operations.
>
> The navigation is confined to flatboats, bateaux, and rafts. No increase of commerce seems to have followed this improvement.

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* Not printed.

The reports of the officers in charge for the following years are as follows:

1884.—There were no operations on this work. There are no reliable commercial statistics available.

1885.—There were no operations except to make an examination of the lower 19 miles of this river, which was found to be in a fair condition. There are no reliable commercial statistics available. There is but little traffic over the river.

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1886.—There were no operations during the fiscal year ending June 30, 1886. * * * No further appropriation is asked for this work.

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1887.—There were no operations during the fiscal year ending June 30, 1887. * * * The proposed improvement should not be completed, as commerce, both present and prospective, does not demand it; therefore no further appropriation is asked for this work.

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A small balance of $246.16 yet remaining of the original appropriations was therefore turned into the United States Treasury and the work dropped from future reports.

Present condition.—The present condition of the river is about as described in the report of 1879, before any improvement was undertaken. It is crossed by three bridges below Courtland, only one of which has a draw. No vessels of any description go up above the Seaboard and Roanoke Railroad Bridge; a few tugs come up this far for rafts of logs.

On Map 1 are shown the various water ways and railroads by means of which freight can be brought from the neighborhood of the Nottoway River to Norfolk, its natural market.

The Nottoway, Blackwater, and Meherrin rivers unite to form the Chowan, which empties into Albemarle Sound. The only all-water route to Norfolk is through this sound to North River and thence to Norfolk via Albemarle and Chesapeake Canal. On account of the distance no shipments are made this way. Freight is ordinarily brought to Franklin, on the Blackwater, and shipped from this point by rail.

The *Keystone*, a steamer of 116 tonnage, drawing 6½ feet, runs on the Blackwater, Meherrin, and Chowan rivers as far south as Gatesville; and the *Lota*, of 138 tonnage, runs between Franklin and Edenton.

As the Atlantic and Danville Railroad passes through the only settlement on the Nottoway River, Courtland, a village of 300 inhabitants, it is not probable that there would be any traffic on this river even if improved so to admit the steamers mentioned above. The freight would be carried, as now, by Atlantic and Danville, and Seaboard and Roanoke railroads.

The inhabitants whom I had the pleasure of meeting while making the examination were generally of the opinion that the improvement would not benefit transportation, but it would protect the farms along the river from inundation by the annual freshets; I do not therefore consider the "Nottoway River from mouth of river to Courtland" as worthy of improvement.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
First Lieut., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 8, 1890.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 3, 1890, of the local engineer it is considered that the Nottoway River, Virginia, is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF CAPTAIN C. B. PHILLIPS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE.
Norfolk, Va., January 18, 1879.

GENERAL: The river and harbor bill of June 18, 1878, provided for an examination or survey of the Nottoway River, Virginia. The field work was undertaken by a party in charge of Mr. W. G. Williamson, who was faithfully and diligently assisted by Messrs. Moncure and Blow, and occupied from the 22d of November until the 3d of December last. The survey was an instrumental one from 1 mile below the Seaboard and Roanoke Railroad to a point about 6 miles above the town of Jerusalem, the county seat of Southampton, a distance of 17 miles.

An examination of the river was made above Jerusalem to Peter's Bridge, and also from the initial point of the survey to the mouth of the river.

Total distance covered by the survey and examination, 50 miles.

The Nottoway River, rising in Prince Edward County, Va., flows in a general southeasterly direction through a very fertile country until it unites with the Blackwater in forming the Chowan River, which empties into the Albemarle Sound at nearly its western extremity. The principal products of the country through which it flows are cotton, corn, peanuts, tobacco, and wheat. Mr. Williamson, in his report, speaks of these products, and gives as nearly as could be ascertained the total amount of crops raised.

Mr. Williamson's report, accompanied by a tracing from the original chart of the survey, is transmitted herewith.

The principal obstructions to navigation in this river, and all that I would at present recommend to be removed, consist of snags, sunken logs, and overhanging trees, and an obstruction near the mouth of the river, placed there by the Confederates during the late war.

Mr. Williamson recommends, and I join with him in his recommendation, that these obstacles be removed without dredging, leaving an available channel of not less than from 7 to 8 feet of water at a low stage from the mouth of the river to Munroe Ferry, a distance of 15 miles, and above that point a channel of from 2 to 3 feet of water at the lowest stage as high as Peter's Bridge.

He also proposes to construct a cheap form of dike a total length of about 2,000 feet at the Narrows, about 1 mile below the crossing of the Seaboard and Roanoke Railroad, for the purpose of concentrating the stream into a single channel at low stage of water.

The improvements suggested seem to be all that are required upon the river and all that prospective commerce will warrant. Mr. Williamson's total estimate for the required work amounts to $6,708.

As the comtemplated work extends over so long a portion of the river, and as the work will be so varied and desultory in its character, I think that his estimate may properly be increased by about 30 per cent., making the total amount required for the proper execution of the work, say in round numbers, $9,000.

This whole amount can be profitably expended in a single fiscal year, and if Congress should see fit to provide for the improvement of this river, it will be judicious to give the whole amount in one appropriation.

The Nottoway River is in the collection district of Norfolk, Va.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, U. S. A.

REPORT OF MR. W. G. WILLIAMSON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 8, 1879.

CAPTAIN: I have the honor to submit the following report of the survey of Nottoway River, made in obedience to your orders of the 19th November, 1878.

The Nottoway River has its source in Prince Edward County, Va., whence, flowing southeast, it forms the boundary line between Nottoway, Dinwiddie, and part of Sussex counties on the north, and Lunenburg, Brunswick, and Greenville counties on the south. From the northeast corner of Greenville County it runs northeast to near the middle of Sussex County, whence, turning southeast by south, it cuts Sussex nearly in half, and continuing its course southeast through Southampton County, dividing it in half, until it reaches the Blackwater River, into which it empties at the junction of Southampton and Nansemond counties, on the North Carolina and Virginia line. The examination included that portion of the river from its mouth to Peter's Bridge, about 20 miles above Jerusalem, the county seat of Southampton County.

That I may describe it more intelligibly I will divide it into three sections, in the order of their examination.

Section 1.—From the mouth of the river to the Narrows, a distance of about 19 miles.

Section 2.—From the Narrows to a point 6 miles above Jerusalem, a distance of 17 miles.

Section 3.—From 6 miles above Jerusalem to Peter's Bridge, a distance of 14 miles.

The distance given for sections 1 and 3 are estimated partly from information derived from persons living on the river and partly from my own judgment. Those for section 2 are from actual measurement.

Section 1 was examined incidentally as I was on my way to the Seaboard and Roanoke Railroad Bridge, the point which your order designated as the initial point of my survey.

Thinking the information might prove valuable I had soundings taken, and the number of snags noted from the mouth of the river to Munroe Ferry, a distance of 15 miles. We found from 9 to 25 feet water in this section, with the exception of three sand bars, on which there were 8 feet. This section of the river is from 150 to 200 feet wide, and boats drawing 4 or 5 feet water can run to Monroe Ferry the year round.

The *Keystone*, a steamer of 116.62 tons, drawing between 4 and 5 feet of water, has been running to Munroe Ferry for 8 months. I am informed by her agent that she gets freight enough to pay expenses, now and then some lumber, shingles, staves, and spokes. There are in this section a number of snags and other obstructions which ought to be removed; among the number an obstruction placed in the river by the Confederates, which has been partially removed, and which should be cleared away entirely. There is one large saw mill on this section, and some fine timber, and several good landings from which boats may be readily loaded.

Section 2 commences about 1 mile below the Seaboard and Roanoke Railroad Bridge, just below that part of the river known as the "Narrows." This mile was included in the survey because it was one of the worst, if not the worst, place on the river, and by taking it within the limits of the survey I was enabled to give a more complete estimate from the mouth of the river to Peter's Bridge.

At the "Narrows" the river is divided into several narrow, crooked chutes. On approaching them it is very difficult for one unacquainted with the stream to find which is the main branch. Trees, snags, saw logs, old boats, and all sorts of floating débris is liable to being stopped here, and consequently the obstruction grows more every day.

The river from this point to Jerusalem, 10.9 miles, is crooked and piled with snags and sand bars to such an extent that, at low water, it would be hazardous for boats drawing 2 feet water to attempt to navigate it, though I believe the removal of these snags would cause the sand bars to assume such a shape as to admit boats drawing 2 feet water to pass probably during the low-water season.

There are three bidges spanning this section which would require draws—the Seaboard and Roanoke Railroad Bridge, Cypress Bridge, 5 miles above, and the bridge at Jerusalem. There are also numerous sharp bends, which are greater obstacles to navigation at high than at low water, as it is very difficult to steer a boat safely around them coming downstream.

There are also many trees leaning over the stream which should be cut away and deposited where they can not be carried into the river. These trees not only interfere with the passage of boats as they are, but are constantly being washed into the river and forming impassable obstructions.

The last stretch of this section, at Jerusalem, is comparatively straight.

Section 3 is decidedly the best portion of the river above the Seaboard and Roanoke Railroad Bridge. The stretches are straighter and longer, and the bends not so abrupt, while there are a few snags. The character of the bottom in all the sections is about the same, consisting mostly of sand. There is one bridge between Jerusalem and Peter's Bridge which would require a draw, that is Carey's Bridge, 10 miles above Jerusalem.

GENERAL OBSERVATIONS.

The citizens in the counties of Sussex and Southampton seem to be anxious that the river should be improved, and they confidently believe it would remunerate a boat and be of great advantage to the farmers along the river—stimulate them to raise crops now neglected for want of transportation. They also claim that emigrants who are now prevented from settling among them on account of the inconvenience experienced in reaching markets would come, cultivate lands already open and lying idle for want of people to work them.

The products of the two counties are cotton, corn, peanuts, pease, wheat, tobacco, Irish and sweet potatoes, apples and fruits of various kinds, and apple brandy. In addition to these products there is fine timber along and contiguous to the river, consisting of cypress, pine, hickory, oak, walnut, etc. Shingles, spokes, and staves are gotten out along its banks, and shipped down the river in flats.

The fish caught in the Nottoway must not be lost sight of. Some of the finest shad caught in Virginia waters are caught in that river.

There are marl beds along the whole course of the river as far as we surveyed it, some of them of fine quality, and might be made valuable as fertilizers and remunerative to boats as freight.

Gen. William B. Shands, a prominent citizen of Southampton, told me that he believed the cotton crop of his county would be for the year 1878, 5,000 bales, and that the peanut crop would amount to 250,000 bushels. Capt. Thomas Pollard, commissioner of agriculture for the State of Virginia, in a letter furnishing me with statistics, puts the cotton crop of Southampton County at 15,000 bales, and that of Sussex at 3,000 bales. If the crops of Sussex are as good in proportion to the size of the county, and we take into consideration the corn and other crops, and the timber trade, it is evident it would pay a boat very handsomely, even admitting she could only get one-fourth of the trade.

I have been unable to obtain any very satisfactory information on which to base an estimate of the probable value of the products which would seek the river as an outlet. I am, however, fully satisfied that a boat drawing 3 feet water, if the river is cleared of obstructions, would be able to run for 9 months in the year and do a good business, and that it might build up a remunerative trade.

I would recommend, however, the use of boats drawing only 2 feet water, and that the river be cleaned out as far as Freeman Bridge, 1 mile from Hawkinsville, on the old plank road, 5 miles from Sussex.

In talking with citizens of the county they suggested lock-and-dam navigation. It may be well for me just here to state that in my opinion such an undertaking would be entirely incommensurate with the advantages to be derived.

In the first place, the two counties most benefited by the improvement lie in a triangle formed by the three following railroads: Petersburg Railroad, Atlantic, Mississippi and Ohio Railroad, and Seaboard and Roanoke Railroad. Farmers living near these roads would ship by them, and if we allow that all the farmers within a triangle formed by taking its sides 5 miles from each of these roads would use the river the amount of freight that would seek the river would not justify such an expensive work.

PLAN OF IMPROVEMENT.

It only remains for me now to suggest a plan of improvement in accord with the ideas expressed above, and to estimate its cost.

I would suggest clearing the river of snags, fish traps, leaning trees, and such other obstructions as cause bars to be formed, whether natural or artificial. I believe removing these obstacles would render the river navigable for 9 months in the year for boats drawing from 3 to 4 feet water, and for the balance of the year for boats drawing 2 feet water.

It would also be advisable to dam up some of the chutes which have been cut by the river, and thereby force the water into its natural bed at ordinary tides. This would have the effect of increasing the depth of water on the sand bars by washing them down, giving a more uniform inclination to the bed of the river, and, as a consequence, a more uniform depth of water. Such an improvement would, I believe, meet the demands of the people.

The following is an estimate of the cost of such an improvement.

The dams, estimated at 50 cents per linear foot, on section 2 are intended to prevent the water at its ordinary stages from running through the numerous cut-offs and to force it into the natural bed of the stream:

Section 1:	
44 snags to be removed, at $10	$440
Removal of leaning trees	50
Removal of Confederate obstructions	1,000
Section 2:	
188 snags to be removed, at $10	1,880
Removal of leaning trees	350
2,000 linear feet low brush-and-stake dams, at 50 cents	1,000
Section 3:	
77 snags to be removed, at $10	770
Removal of leaning trees	100
	5,590
Add for superintendence, engineering, and contingencies, 20 per cent	1,118
Total	6,708

I annex a statement furnished me by Mr. James F. Manpin, agent Seaboard and Roanoke Railroad, showing the amount of freight transported over that road from the three stations nearest the Nottoway, viz: Franklin, Handsomes, and Nottoway. I think it probable, if the river was opened to navigation, that most of this freight would be shipped at Nottoway Station, and that a great deal more, which is now hauled to other depots, would seek the river as an outlet.

A statistical statement of the freights transported from Franklin, Handsomes, and Nottoway by the Seaboard and Roanoke Railroad during the year 1878.

From—	Cotton.	Peanuts.	Pease.	Merchandise.	Lumber.	Shingles.	Staves.
	Bales.	*Bags.*	*Bags.*	*Pounds.*	*Cars.*	*Cars.*	*Cars.*
Franklin	469	9,044	541	144,330	353		
Handsomes	368	1,240	34	14,376	63		
Nottoway	269	3,136	48	21,675	93	1	3
Totals	1,106	13,420	623	180,381	509	1	3

JAMES F. MANPIN, *Agent.*

Very respectfully, your obedient servant,

W. G. WILLIAMSON,
Assistant Engineer.

Capt. C. B. PHILLIPS,
Corps of Engineers, U. S. A.

K 14.

PRELIMINARY EXAMINATION OF NORTH-WEST RIVER, NORTH CAROLINA, UP TO MOYOCK.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., April 23, 1891.

GENERAL: I have the honor to submit the following report, with maps, of an examination of North-West River up to Moyock:

A personal examination was made of this river, and one by Assistant Engineer J. P. White, whose report is hereunto attached.

As Moyock is not on North-West River, but on one of its tributaries, Shingle Landing Creek, the examination was made to include this stream. The character of the country along the river and the hydrography of the same is given in full in Mr. White's report.

As the object of the improvement was to benefit Moyock particularly, my attention was was given specially to determining the probable amount of shipments from this place.

Moyock is a village of about 100 inhabitants on the Norfolk Southern Railroad, 24 miles from Norfolk by railroad and 54 by water. It has several stores, warehouses, a cotton gin, and is the shipping point for the surrounding territory.

Mr. M. K. King, general manager of the Norfolk Southern Railroad, kindly gave me the following statistics of the shipments over his line from October 1, 1889, to October 1, 1890:

Forwarded from Moyock to Norfolk, October 1, 1889, to September 30, 1890:		
Cotton	bales..	233
Wood	cords..	58
Shingles	number..	15,000
Corn	bushels..	1,012
Cattle	number..	429
Miscellaneous	packages..	1,323
From Moyock to points north of Norfolk, October 1, 1889, to September 30, 1890:		
Corn shucks	bales..	2,625
Corn	bushels..	16,359
Miscellaneous	packages..	614

A petition hereunto attached gives the entire estimated shipments from this place.

To secure the navigation desired by the people of Moyock a channel at least 40 feet wide and 8 feet deep should be dredged near the mouth of North-West River and the entire length of Shingle Landing Creek. The estimated cost of such a channel is as follows:

North-West River, 73,333 cubic yards, at 30 cents	$21,999.60
Shingle Landing Creek, 94,249 cubic yards, at 30 cents, including turning basin	28,274.70
	50,274.30
15 per cent. for engineering and contingencies	7,547.14
Total	57,821.44

As there are no freshets on these rivers the improvement, if undertaken, would probably be permanent. The improvement of the North-West River would benefit all the country lying along its banks, but that of Shingle Landing Creek would only benefit the village of Moyock.

Although the improvement of these streams would undoubtedly benefit the surrounding country in providing a line of transportation to compete with the Norfolk Southern Railroad, the amount of commerce to be expected does not seem to justify the cost of such an undertaking.

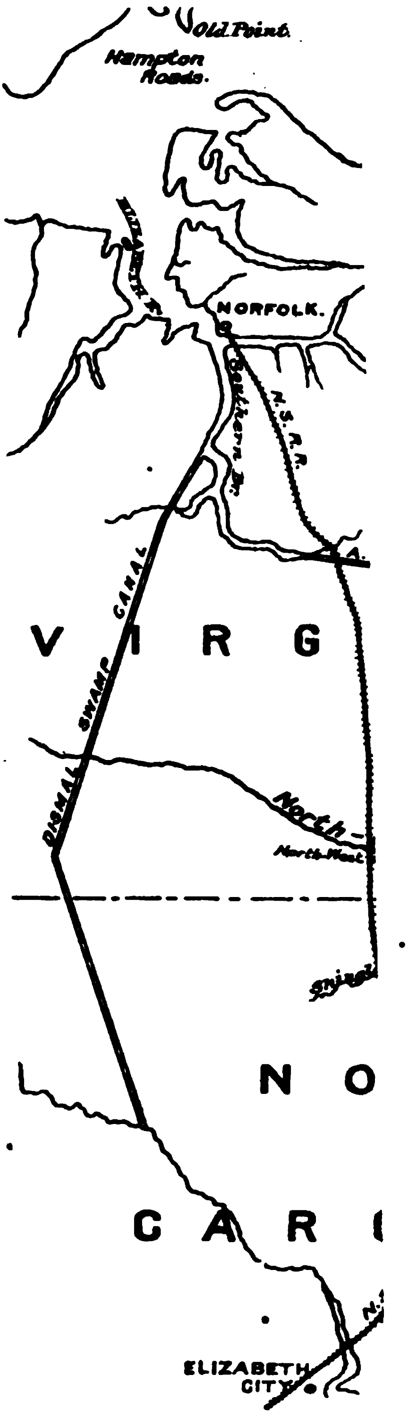
I would therefore report that the "North-West River up to Moyock" is not worthy of improvement.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division).


Old Point
Hampton Roads
NORFOLK.
Southern Br.
N. S. R. R.
A.
DISMAL SWAMP CANAL
V I R G
North
North West
N O
C A R
N.S
ELIZABETH CITY

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., April 29, 1891.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons set forth in the report of the local engineer and from my own general knowledge of the situation I am of the opinion that North-West River up to Moyock is not worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. J. P. WHITE, ASSISTANT ENGINEER.

NORFOLK, VA., *January 15, 1891.*

SIR: I have the honor to submit the following report of an examination of North-West River, from its headwaters to its junction with Currituck Sound, made by me in November and December, 1890:

This river rises in the Dismal Swamp, about 2 miles from Lake Drummond, and flows through a culvert under the Dismal Swamp Canal at Wallaceton.

For a distance of 6 miles from Wallaceton it gradually increases from a ditch or drain to a stream 50 feet wide and 5 feet deep. It is not passable for a small rowboat on account of obstructions. At Bethel, 6 miles below Wallaceton, the river was at one time much used for rafting timber. The supply is now about exhausted. From Bethel to Woodward's Bridge, 3 miles, the river widens to 65 feet and is bordered by swamps about a mile wide. It is very tortuous and full of sunken logs. From Woodward's Bridge to North West Station, 5¼ miles, the river is 10 feet deep. It is, however, full of sunken logs and crooked.

At North-West Station it is crossed by two bridges, with draws of 28 and 18 feet.

From North-West Station to its junction with Tull Creek, a distance of 12 miles, the river has a deep, wide channel, the depth at least 10 feet, except for a distance of 400 yards, where the depth is about 6 to 7 feet. From this point to Currituck Sound the channel has a depth of 12 feet, except at its mouth, where there is a shoal one-half mile long, with a depth of only 5 feet. The dredged channel through Currituck Sound is 9 feet deep, but is separated from the mouth of North Landing Creek by a distance of 1¼ miles, over which the depth is from 6 to 6¼ feet.

Shingle Landing Creek.—This is one of the principal tributaries of North-West River. It rises near the village of Moyock, and is 2¼ miles long. For a distance of 700 yards below the village this stream is about 36 to 50 feet wide and 3 to 6 feet deep. From this point to a distance of one-half mile from the village it is 50 feet wide and 5 to 7 feet deep, and below this 80 to 100 feet wide and at least 6 feet deep. There are a great many sharp bends in the river, which would require straightening to make this stream navigable.

Tull Creek has a channel about 6 feet deep.

Country and products.—The country drained by this river and its tributaries is fertile, especially around its upper course, and fairly well settled. The principal products are corn, peanuts, cotton, and garden truck. Fish are also taken from the river. No accurate estimate could be obtained of the annual amount of these products. The business on Tull Creek was given me as $2,500 a year.

Means of transportation.—At present the products of the country are taken to Norfolk (1) by the Dismal Swamp Canal; (2) by the Norfolk Southern Railroad; (3) by a steamer, *Helen Smith*, which runs up Tull Creek to Tull's Landing. These means seem to suffice for the present needs of the country. From what I saw I do not believe the business would support a steamer on North West River.

Very respectfully, your obedient servant,

J. P. WHITE,
Assistant Engineer.

Capt. G. J. FIEBEGER,
Corps of Engineers

PETITION OF CITIZENS OF MOYOCK, NORTH CAROLINA.

MOYOCK, N. C., *April 16, 1891.*

Petition for improvement of North West River and branch to Moyock, N. C.

We the undersigned, shipping our produce from Moyock (formerly called Shingle Landing), in the State of North Carolina, do earnestly petition the Government of the United States to make such appropriation as is necessary to so improve North West River and branch to Moyock by removing bars, obstructions, and straightening at such points as the engineer in charge deems necessary, so that boats drawing water to the depth allowed boats plying through the Albermarle and Chesapeake Canal can do business to and from Moyock without danger, and thereby giving the inhabitants of this section such transportation as will benefit them and encourage immigration.

Business done at this point during last year approximately was as follows: 100,000 bushels of corn, 600 bales of cotton, 2,000 tons of other farm products.

Merchandise, tools, fertilizers, etc., amounting in value to $100,000 were distributed from Moyock.

The farming lands are of very good quality; climate even and general health above the average. The stream that we ask to be improved was, before 1860, navigable, so that vessels loaded which sailed direct to the West Indies with staves, headings, etc.

THOMAS L. JARVIS,
(and 18 others).

To G. J. FIEBEGER,
Captain, Corps of Engineers, U. S. A.

K 15.

PRELIMINARY EXAMINATION OF WEST NECK RIVER, TO AND BEYOND DOZIER'S BRIDGE, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., March 13, 1891.

GENERAL: I have the honor to submit the following report with maps* of a preliminary examination of "West Neck River, to and beyond Dozier's Bridge."

This river is a tributary of the North Landing and rises in a swamp north of Princess Anne. For about 8 or 10 years it has been used for flatboats as far as Owen's Bridge, but the upper part was very crooked. In December, 1889, and January, 1890, the county of Princess Anne in connection with Messrs. Owen and Bennett undertook to dredge a cut-off about 500 yards long to straighten some of the worst bends, and allow the smaller class of steamers now running between Norfolk and the Currituck Sound landings to run as far as Owen's Bridge. On account of want of funds, this work was never satisfactorily completed, and these steamers can only occasionally make this trip during very high water. A small steamer about 37 feet long, the *Hope*, now makes daily trips between Owen's Bridge and the mouth of the river, in connection with one of the lines of steamers above mentioned. The amount of freight shipped from Owen's and West Neck landings, judging from the freight receipts, is about $50,000 a year. In addition to the above from Owen's Mill are shipped about 2,000,000 shingles and 500,000 feet of lumber.

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* Not printed.

With better transportation facilities these amounts would undoubtedly be increased, as West Neck River affords an outlet for a large tract of country, which has no other convenient lines of transportation and has very poor country roads.

I therefore consider this river worthy of improvement in so far as to admit the smaller class of steamers running between Currituck Sound and Norfolk as far as Owen's Bridge. These boats are not over 100 feet long, 20 feet wide, and have a draft not to exceed 6 feet. They can now run within one-half mile of Owen's Bridge, and in this distance are impeded only by a shoal at the mouth of the river and one short bend. The upper half mile, including the cut-off, needs widening, and the turning basin, partly dredged, should be finished. In addition to the above, some logs and obstructions will need removing.

From the map made by Mr. White, assistant engineer, and a personal examination, the cost of this improvement is estimated as follows:

	Cu. yds.
Turning basin, about 120 by 120 feet and 7 feet deep	5,000
Cut-off widened to 20 feet bottom width, 7 feet deep, 500 yards long	15,000
Removal of sharp bends and shoal at mouth of river	5,000
Total	25,000
At 30 cents per cubic yard	$7,500
Clearing river of obstructions, engineering, and contingencies	1,500
Total	9,000

As the river is sluggish and not subject to severe freshets, any improvement made will be liable to little deterioration.

At Owen's Landing the river is crossed by a bridge without a draw, and above this is simply a drain, which has never been used for purposes of navigation. I do not, therefore, consider the river above Owen's Bridge as worthy of improvement.

No additional survey is deemed necessary to estimate the cost of this improvement.

Very respectfully, your obedient servant,

G. J. FIEBEGER,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., March 16, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of the local engineer, West Neck River is considered worthy of improvement to the limited extent indicated herein as high as Owen's Bridge but not higher.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. J. P. WHITE, ASSISTANT ENGINEER.

NORFOLK, VA., *December 6, 1890.*

DEAR SIR: I have the honor to report the following examination of West Neck Creek made according to your instructions:

Up to West Neck Bridge, 2 miles from its mouth, this creek has a channel depth of 6 to 8 feet. The channel is narrow and crooked at the mouth, but light vessels enter readily, the bottom being soft mud. The stream is somewhat obstructed by sunken logs. West Neck Bridge has a draw 20 feet wide, water 6 feet deep.

For 2 miles above West Neck Bridge the river retains its depth, but narrows down and becomes one of a number of small drains through the surrounding swamp. From this point a canal has been cut through the swamp to Owen's Bridge. It is about a half-mile long, 30 feet wide, and 6 to 7 feet deep.

From Owen's Bridge to Dozier's Bridge is about 1½ miles.

The creek between these points is nothing more than a gum swamp—mud and water about 3 feet deep and full of large trees.

The country produces garden truck. Most merchandise is brought by water from Norfolk. Dozier's Bridge is within three-fourths of a mile of Princess Anne. The country has no facilities for transportation. The *Hope* runs up the river as far as Owen's Bridge and does about $250 worth of business a month. It is claimed that merchandise to the value of $50,000 is carried to West Neck Bridge each year and that if a canal were cut to Dozier's Bridge the trade would be increased by $50,000 at least. There is a large body of good timber around the head of the creek. The country is capable of high agricultural development, producing garden truck earlier than that around Norfolk. The farmers say that the difficulty in getting fertilizers is a hindrance to them.

Most respectfully, your obedient servant,

J. P. WHITE,
Assistant Engineer.

Lieut. G. J. FIEBEGER,
Corps of Engineers, U. S. A.

APPENDIX L.

IMPROVEMENT OF STAUNTON RIVER, VIRGINIA, OF ROANOKE RIVER, VIRGINIA AND NORTH CAROLINA, OF CERTAIN RIVERS AND WATER-WAYS IN NORTH CAROLINA, AND OF BEAUFORT HARBOR, NORTH CAROLINA, AND GEORGETOWN HARBOR AND WINYAW BAY, SOUTH CAROLINA.

REPORT OF CAPTAIN W. H. BIXBY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Staunton River, Virginia.
2. Roanoke River, Virginia and North Carolina.
3. Pasquotank River, North Carolina.
4. Mackey Creek, North Carolina.
5. Ocracoke Inlet, North Carolina.
6. Fishing Creek, North Carolina.
7. Pamlico and Tar Rivers, North Carolina.
8. Contentnia Creek, North Carolina.
9. Trent River, North Carolina.
10. Neuse River, North Carolina.
11. Inland water-way between New Berne and Beaufort, North Carolina.
12. Harbor at Beaufort, North Carolina.
13. Inland water-way between Beaufort Harbor and New River, North Carolina.
14. Water-way between New River and Swansboro, North Carolina.
15. New River, North Carolina.
16. North East (Cape Fear) River, North Carolina.
17. Black River, North Carolina.
18. Cape Fear River, North Carolina, above Wilmington.
19. Cape Fear River, North Carolina, at and below Wilmington.
20. Lockwood's Folly River, North Carolina.
21. Yadkin River, North Carolina.
22. Harbor at Georgetown, South Carolina.
23. Winyaw Bay, South Carolina.
24. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

25. Water-way from Pungo River to the town of Sladesville, North Carolina.
26. Water-way between Pamlico River and Bay River, North Carolina.
27. Drum Inlet, North Carolina.
28. Harbor of Washington, Pamlico River, North Carolina.
29. White Oak River, North Carolina, from Roberts Landing to Collins Crossing.
30. Black River, South Carolina, from Kingstree to its mouth.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., July 10, 1891.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1891, upon the works of river and harbor improvements then in my charge.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

L I.

IMPROVEMENT OF STAUNTON RIVER, VIRGINIA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For estimate of cost of improvement and for special description of the river from Pig River down to Virginia Midland Railroad Bridge, see pages 1047 to 1052 of Annual Report for 1882 and pages 827 to 829 of Annual Report of 1883; of the river from Virginia Midland Railroad down to Brook Neal, see pages 1047 to 1052 of Annual Report for 1882; and of the river from Brook Neal down to Randolph Station (formerly called Roanoke) on the Richmond and Danville Railroad, see pages 622 to 624 of Annual Report of 1879 and pages 781 to 787 of Annual Report for 1880.

For maps of the river from Pig River to Virginia Midland Railroad, see page 836 of Annual Report for 1888, and from Brook Neal to Randolph, see page 786 of Annual Report for 1880. For description of whole river basin, see pages 702 to 707, Part I, report on water power of United States, Department of Interior, 1885, Mis. Doc. 42, Part 16, Forty-seventh Congress, second session.

(2) *Original condition.*—The Staunton River, joining the dam at Clarksville to form the Roanoke, has, with its tributaries, a total length of about 200 miles, and a drainage area of about 3,450 square miles.

The portion from Pig River to the Virginia Midland Railroad was placed under Governmental improvement in 1882, and the portion from Brook Neal to Randolph in 1879. At these dates the upper portion possessed an average slope of 4.3 feet per mile and a general channel depth of over 2 feet at ordinary stages of water, except at about 30 rock shoals, where it was only 0.4 feet, and the lower portion possessed an average slope of 1.2 feet per mile, and a general channel depth of 4 to 5 feet at low water, except at about 18 rock ledges or shoals, where it was only about 1 to 2 feet at low water.

The upper portion was then navigated by 8 bateaux of 20 inches draft, carrying each about 12 tons; it is about 150 to 350 feet wide, subject to freshets of from 20 to 30 feet height.

The lower portion was then navigated by bateaux at all times, and at mean winter water by 1 steamer of 14 inches draft. It is from 260 to 500 feet wide, with banks 12 to 22 feet high, and subject to freshets of from 30 to 43 feet height.

The commerce of the upper portion was estimated to have been $40,000 (6,000 tons) per year, and that of the lower portion $100,000 (1,000 tons) per year.

(3) *Plan of improvement.*—The original projects of 1883 for the upper portion and of 1879 for the lower portion, as modified to date, propose to secure a bateaux channel way of 14 feet breadth, 1½ feet depth at low water for 23.5 miles from Pig River to the Virginia Midland Railroad, and of 35 feet breadth, 2 feet depth, at low water, and of not over 10 feet slope per mile for 31.5 miles from Brook Neal to Randolph.

The total final cost of this work was estimated in 1888 at $102,700 ($34,000 from Pig River to Virginia Midland Railroad, $68,700 from Brook Neal to Randolph).

The two works were consolidated in 1890.

The aggregate amount appropriated for these projects up to June 30, 1891, is $52,500.

Fifty thousand two hundred dollars more is needed to complete the existing projects.

(4) *Results.*—Up to 30th June, 1890, a total of $44,314.53, including outstanding liabilities, had been spent in all upon this improvement, securing the proposed navigation for 18½ miles above the Virginia Midland Railroad and for 29.5 miles of the middle portion of the distance between Brook Neal and Randolph.

The improvement has not yet been completed far enough to produce any special increase of commerce. Such results can not be expected to any great extent until the work is completed.

The navigation of this river is not reported to be obstructed by bridges without draws; wherever railroads cross over this river their crossings become natural shipping points, so that at present boats do not desire to pass through their bridges.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the year is as follows: Expenditures, including outstanding liabilities, $203.73; value of United States plant, $650.

Prior to the appropriation of September, 1890, all work in the field was suspended for want of funds. From 30th June, 1890, to 10th July, 1890, this work was in charge of S. T. Abert, U. S. agent, and from 10th July, 1890, to 14th November, 1890, it was in charge of Col. P. C. Hains, Corps of Engineers.

From September, 1890, to June, 1891, work in the field was prevented by high water.

Inspections of property were made during the year.

A new railroad has lately been finished by private parties, crossing the river near Brook Neal; so that at least one side of the river basin is now provided with good transportation facilities, lessening considerably the need of river transportation. Otherwise the general situation remains about the same as at the commencement of the year.

The latest available commercial statistics, those of the year ending 31st December, 1890, are herewith appended, showing a commerce of about $31,400 (about 300 tons) per year.

(6) *Recommendations for future work.*—The shallow draft, rocky bottom, steep slope at ledges, and available stages of water, and the existence now of two railroads near the main shipping points of the river basin, render quite doubtful the advantage and economy of further improvement of the navigation of this stream at the present time. On this account it is recommended that no further appropriations be made until after further special examinations of the results of past work and the cost and prospective benefits of any future work.

Money statement.

July 1, 1890, balance unexpended	$185.47
Amount appropriated by act approved September 19, 1890	8,000.00
	8,185.47
June 30, 1891, amount expended during the fiscal year	203.73
July 1, 1891, balance unexpended	7,981.74
July 1, 1891, outstanding liabilities	34.74
July 1, 1891, balance available	7,947.00
Amount (estimated) required for completion of existing project	50,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

When work commenced in 1879 the navigation of the river above Randolph Station (formerly Roanoke) on the Richmond and Danville Railroad was carried on by light-draft bateaux or pole boats. The river commerce was then mostly in tobacco and ores and is now estimated to have then been about $140,000.

To-day other railroads cross the river and most of the river valley's commerce goes naturally to market by rail.

The improvement has not yet been completed far enough to add much to through facilities of navigation.

The present commerce, therefore, remains about the same as in 1879, that is, usually about $140,000; but it naturally varies above or below this according as the year is good or bad as to farm crops. With favorable crops the river commerce should amount to about $200,000 (5,000 tons) per year.

During the year ending 31st December, 1890, the river was navigated by 6 or 8 bateaux and one steamer making irregular trips during about 8 months of the busiest part of the year. However, many severe freshets washed away or destroyed the main wheat and tobacco crops and reduced the annual river commerce to about one quarter of its usual amount.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Tobacco	$10,800		$18,000	70
Sumac	150		150	8
Grains and forage	6,450		6,450	300
Lumber and products	1,000		1,000	125
Fertilizers	2,500		2,500	100
General merchandise	500	$18,000	18,500	200
Total	21,400	18,000	31,400	803

Transportation lines established during year, none.

The above statistics are based mainly upon information furnished by Mr. H. A. Moseley, Randolph, Va.

The commerce at present as above shown is 800 tons, $31,400; expended on improvement up to 31st December, 1890, $44,500.

L 2.

IMPROVEMENT OF ROANOKE RIVER, VIRGINIA AND NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For estimates of cost of improvement and for special description of river below Weldon, see pages 726–733, Annual Report for 1872, and page 1022 of Annual Report for 1884; and for map of river, see page 1110 of Annual Report of 1890, and for the river above Weldon, see page 1060, Annual Report of 1882, and page 960 of Annual Report for 1887, and pages 1175–1179 of Annual Report of 1890.

(2) *Original condition.*—The Roanoke River, entering into the Albemarle Sound, has with its tributaries a total length of about 400 miles and a drainage area of 9,200 square miles (2,050 of which are situated below the confluence of its two main tributaries, the Dan and Staunton).

When placed under governmental improvement, in 1872, this stream possessed a 10-foot depth of channel from its mouth 62 miles up to Hamilton, thence a 5-foot depth 67 miles further to Weldon (about 8 months per year), this channel depth being reduced during the low-water season to 10 feet to Hamilton and 2 feet to Weldon. Over the whole 129 miles, the river was more or less obstructed by snags, fallen trees, rocky bars, and by war obstructions. Its commerce, carried by steamboat navigation, was estimated to have then been about $3,500,000.

(3) *Plan of improvement.*—The original projects of 1872 as since continued to date contemplated the removal of the war blockades, a few rocky bars, and all sunken logs, snags, floating and other obstructions, and the contraction of the channel way by jetties so as to assure during the entire year an unobstructed 10-foot navigation up to Hamilton, and 5-foot navigation up to Welden. A personal examination of the river in 1888 revealed the agricultural richness of the whole river basin, its need of free transportation facilities, and the worthiness of the improvement below Weldon.

The total final cost of this work below Weldon was estimated in 1872 at $269,000 for a steamboat channel of 5 feet depth at low water.

The aggregate amount appropriated for these projects up to June 30, 1891, is $138,000.

The funds now on hand will be nearly all used up before new appropriations can become available.

(4) *Results.*—Up to June 30, 1890, a total of $102,034.82, including outstanding liabilities, had been spent, in all, upon this improvement, giving a moderately well cleared channel over the entire length of the river, allowing a 10-foot navigation 62 miles to Hamilton, and a fairly well cleared 5-foot navigation 67 miles further to Weldon all the year, at ordinarily low water.

Fifteen steamboats were then running on the river, and the river commerce had increased up to (in poor years) about $5,000,000, and (in good years) about $14,000,000, of goods transported per year, showing that each dollar once spent on this improvement has been accompanied by the development of about from $50 to $140 of annual commerce.

The navigation of this river was not obstructed by bridges without draws.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the year is as follows: Expenditures, including outstanding liabilities, $17,005.55; value of United States plant, $7,350.

During the year two United States steam hoisters, one small steam launch, two small floating hand-winches and other plant were in use (one of the hoister engines having been borrowed from the Neuse River works).

Owing to the difficulty and expense of properly specifying it beforehand and measuring it afterward, all work was, for advantage and economy, done by hired labor and purchase of materials in open market.

Prior to March, 1890, the projecting rock bottom of the river at Weldon and Halifax had been blasted and loosened up enough to insure a channel of 100 feet width and 4 feet depth at Weldon, and 60 feet width and 3 feet depth at Halifax, at low water; but the loosened rock still remains unremoved awaiting a stage of low water advantageous to such work.

From 1st July to 19th July, 1890, one dredge, the *Nannie*, hired under agreement dated September 2, 1889, from Joseph Baker, of Berkley, Va., has been at work on the obstructions in the river.

This dredge worked at Big Rocky Bar (95 miles above the river mouth) from 1st July to 3d July, 1890, completing work at this point.

The material removed, consisting of sand, coarse gravel, and bowlders, has been deposited on both banks of the cut, which was 138 feet wide and 5 feet deep at dead low water.

This dredge also worked at Shad Island Bend (30 miles above the river mouth) from July 4 to July 19, 1890, removing 3,030 cubic yards of mud and clay from 333 linear feet of cutting 23 feet wide and 7 feet deep below the surface of the ground, commencing at the downstream end of the proposed cut (see map, page 1,110 of Annual Report of 1890). Work was then postponed to await full cession of rights of way across the bend to be secured and donated by the owners of the river steamboat lines.

Bank trimming and the removal of the worst obstructions from the river channel have been carried on where most needed over the entire length of the river below Weldon; and the channel is now well cleared.

During the year there were removed—

From the banks:	
Trees cut and pulled back	2,939
Trees trimmed	56
Cords of brush cut	39
From the channel:	
Large snags	5,901
Logs	28
Stumps	602
Cords small snags	110

The Roanoke River launch *Nell*, having been disabled by a snag in July, 1890, the launch *H. G. Wright*, borrowed from the upper Cape Fear River, was used in her place a large part of the year. Meanwhile the *Nell* was rebuilt, being completed in June, 1891.

In July and October, 1890, by Asssistant Engineer Charles Humphreys and steam launch *H. G. Wright* (borrowed from Cape Fear River), mile posts were established over the entire length of river, to serve as points of reference in reporting obstructions and laying out future work; and minor surveys were made at Burgwyn Shoal (109 miles above mouth of river) and at Bell Bar (113 miles above mouth of river) with reference to future dredging.

Six water-gauge records were kept during the year.

Inspections of property and progress of work were made during the year.

Work during the year has been considerably interfered with by unusually and excessively high water.

The work of this improvement during the year was well and efficiently carried on under the immediate supervision of Overseer Charles Schuster, whose report is herewith appended.

The work of the past year has much improved the navigable condition of the river over its entire length and the commerce is steadily increasing.

The dredged channels at Big and Little Rocky bars now permit steamers drawing 5 feet to ascend the river to Weldon at ordinary low water. The worst obstructions have been removed from the channel, and the removal of overhanging trees, brush, etc., has much facilitated the passage of the worst bends on the river.

Late work upon the various bars of the river has been so much less expensive than anticipated, that it is probable a single further appropriation of $40,000 will complete all work at present advantageous on this river; but definite statements on this subject should await the result of further surveys and examinations during the next low-water season.

Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $4,193,130 per year (about 182,700 tons).

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original projects, so as to secure a thoroughly cleared 10-foot navigation up to Hamilton, and a similar 5-foot navigation to Weldon, during the entire year, at a total expense of $131,000, if necessary, in addition to the funds available June 30, 1891; this amount to be appropriated in yearly installments of as much as $60,000 each. Smaller yearly appropriations, involving the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and the deterioration of plant may increase the cost of the work by from $2,000 to $6,000 per appropriation. Further improvement, so as to extend the navigation above Weldon, or so as to increase the depth of water or length of time of such navigation below Weldon, is not recommended at present.

After the improvement is finished, its proper maintenance may cost from $2,000 to $6,000 per year.

This river is in the collection district of Albemarle, and the nearest port of entry is Edenton, N. C. The nearest light-house is the Roanoke River Light.

Money statement.

July 1, 1890, balance unexpended	$12,536.22
Amount appropriated by act approved September 19, 1890	25,000.00
	37,536.22
June 30, 1891, amount expended during fiscal year	17,552.23
July 1, 1891, balance unexpended	19,983.99
July 1, 1891, outstanding liabilities	1,024.36
July 1, 1891, balance available	18,959.63
Amount (estimated) required for completion of existing project	131,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. CHARLES SCHUSTER, OVERSEER.

UNITED STATES ENGINEER OFFICE,
Scotland Neck, N. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations upon the improvement of the Roanoke River, North Carolina, during the past fiscal year:

Detailed surveys were made of Burgwyn Shoal and Bell Bar, 109 to 113 miles above the mouth of the river; and mileposts set from river mouth to Weldon by Mr. Charles Humphreys, assistant engineer with U. S. Steamer *General Wright* and crew, July 28 to October, 1890.

Dredging was finished at Big Rocky Bar July 3, 1890, and during July, 1890, 672 cubic yards of mud and sand were removed. This completes the channel through Big Rocky Bar for its entire length 138 feet wide and 5.5 feet deep at dead low water. (For details see final report on this work).

After finishing the work of dredging at Big Rocky Bar the dredge was removed to Shad Island Bend, and started work on first cut of proposed channel there July 8, 1890. One cut was made 7 feet deep below the general surface of the bank 23 feet wide and 333 feet long, 3,030 cubic yards of mud were dredged and thrown on bank. This work was stopped July 21, 1890, to wait cession of right of way, and the hired dredge and other plant were delivered to Joseph Baker, owner, at Plymouth, N. C., July 25, 1890.

The snagging has been done during the past year on the river below Big Rocky Bar at such places as required immediate action, owing to sliding banks or single trees falling in river. The upper river, from Weldon to 102d milepost, has been thoroughly cleared of all snags to a depth of 5 feet below dead low water and the full natural width of channel. In all, the following obstructions have been removed from the river channel:

Large snags	5,901
Logs	28
Stumps	602
Small snags (cords)	110
Piles pulled up	40

Bank trimming has been done during the past fiscal year where necessary from Edwards Ferry to Jamesville: distance 84 miles.

This completes the work of bank trimming on the entire river, except at such places and bends where the current is eroding the bank and undermining the trees.

The following obstructions were removed from the banks;

Trees cut and hauled back	2,939
Trees trimmed	56
Brush cut (cords)	39

Gauge observations was taken daily during the past year at Weldon, Norfleet Ferry, and Jamesville, and since February 1, 1891, at Hamilton, Williamston, and Plymouth. The plant employed on this river is valued at $7,350.

United States steam launch *Nell*, while on her way from Plymouth to Norfleet Ferry, struck a submerged snag, which knocked a plank off her bottom 8 feet long. The boat sank in about 30 feet of water near Poplar Point on 26th July, 1890. She was raised August 27 to 29, but owing to the rottenness of the old hull, a new hull was built and a new engine bought, at a total cost of $897.64.

After the detailed surveys of Burgwyn Shoal and Bells Bar were finished the U. S. steam launch *General Wright* was kept on Roanoke River until January 10, 1891, when she towed hoister *Roanoke* from Roanoke River to Pasquotank River, and was sent from there to New Berne, N. C., and delivered to Superintendent Ransom.

Hoister *Roanoke* was used on Pasquotank River, North Carolina, from January 10 to April 25, 1891.

Very respectfully, your obedient servant,

CHAS. SCHUSTER,
Overseer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1872 the river was badly obstructed by leaning trees, snags, rocky bars, and war obstructions.

Its commerce is estimated to have then been $3,500,000 of goods transported per year.

Eight large steamers of 6 to 9 feet draft are now constantly used and 5 others make irregular trips on the lower part of the river, and 1 light-draft steamer makes 2 trips per week on the upper river to within a few miles of Weldon. Two new landings have been established on the upper part of the river, one at Haliax and one 4 miles below Weldon. This is the first time since 1860 that navigation has been available higher than a point 14 miles below Weldon.

The present rates of freight are very much lower than in 1872, and river marine insurance is now very small.

Each dollar so far spent upon this improvement has been accompanied by the development of about $5.00 of annual commerce.

The lumber business has greatly increased during the past year, several new mills have been established, and a large cross-tie and shingle trade worked up.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$1,182,600	....	$1,182,600	6,550
Tobacco	7,600	$8,200	15,800	25
Rice	7,900	....	7,900	75
Grains and forage	71,600	16,800	88,400	2,300
Vegetables and truck	12,400	....	12,400	3,800
Live stock and products	6,500	2,570	9,070	80
Fish, oysters, etc	52,980	11,600	64,580	870
Naval stores	3,900	....	3,900	210
Lumber and products	711,250	....	711,250	154,350
Coal and minerals	....	500	500	90
Fertilizers	3,000	88,640	91,640	2,200
Machinery	1,200	32,500	33,700	130
General merchandise	285,700	1,685,000	1,970,700	12,000
Sundries	....	690	690	20
Total	2,346,630	1,846,500	4,193,130	182,700
Increase				23,000
Decrease over last year			792,870	

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Overseer Charles Schuster, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and promiment shippers and merchants.

	Amount.	Tons.
The commerce at present, as above shown, is	$4,193,130	182,700
The commerce before the improvement began was	3,500,000	150,000
The development of commerce since the beginning of the improvement is	693,130	32,700
Expended on improvement up to 31st December, 1890	113,000	....
The development of annual commerce for every dollar spent on the improvement is	5	....

L 3.

IMPROVEMENT OF PASQUOTANK RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of river see pages 1,135–1,137 of Annual Report for 1889. (For map of the river see end of present report.)

(2) *Original condition.*—Pasquotank River has a total length of about 51 miles and a drainage area of about 200 square miles, emptying into Albemarle Sound. It forms a part of an important canal and river route from Norfolk to Albemarle and Pamlico sounds.

When placed under governmental improvement in 1890, this stream possessed a fairly cleared 9-foot navigation upward 31 miles to the lower mouth of Turner's Cut; thence a poorly cleared 5-foot navigation upward 5 miles to the upper end of Turner's Cut; thence a badly obstructed 3 to 4 foot navigation for flats and narrow barges upward 6 miles to Lebanon Bridge. Its commerce was then estimated at about $900,000 or about 150,000 tons, being carried on by barges, schooners, and steamers which made trips over the route during high water.

(3) *Plan of improvement.*—The original project of 1889, as continued to date, assumed that 9 feet draft could be carried from Albemarle Sound to the lower end of Turner's Cut, and proposed to secure a well-cleared 5-foot navigation 5 miles farther, between the ends of Tur-

ner's Cut for the use of canal boats, and to thoroughly clean out the river to its full natural width and depth for the next 6 miles for the use of flats and barges.

The total final cost of such work was estimated in 1889 to be $9,000.

The aggregate amount appropriated for this project up to the 30th of June 1891, is $3,000.

The funds now on hand will be exhausted before new appropriations can become available.

(4) *Results.*—Up to the 30th of June, 1890, no funds had been voted and no work done. No results can be expected before 1892.

The navigation is not obstructed by bridges within the 42 miles under improvement.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $2,340.28; value of United States plant, nothing.

Project for this improvement was approved in October, 1890; all the funds to be spent for snagging and bank trimming, including the cutting away of projecting points of bank at sharp bends of river, water-gauge observations, surveys, occasional blasting, and office and minor work.

During the working season one hoister and the necessary flats, tools, etc., were at work.

Owing to its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterward, all work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

Between January and April, 1891, and from the 5 miles of river between the ends of Turner's Cut, 471 large snags, 342 sunken logs, 801 stumps, 9 cords of small snags, and one old wreck were removed from the channel, and 65 overhanging trees were cut and pulled back from the river banks, leaving a fairly well-cleared channel of 60 feet width and about 5 feet depth over the entire distance.

Further work was stopped in April by the near exhaustion of funds; a small amount being reserved for contingencies.

A minor survey of this part of the river was made in April.

One water gauge was kept during the year.

The work of this improvement was well and efficiently carried on during the year under the immediate supervision of Overseer Charles Schuster, whose report is herewith appended.

As a result of the year's work, canal barges and one line of steamers make regular trips from Elizabeth City (near mouth of river) to Norfolk at all stages of water. Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are hereto appended, showing a commerce of about $900,000 (about 150,000 tons) per year.

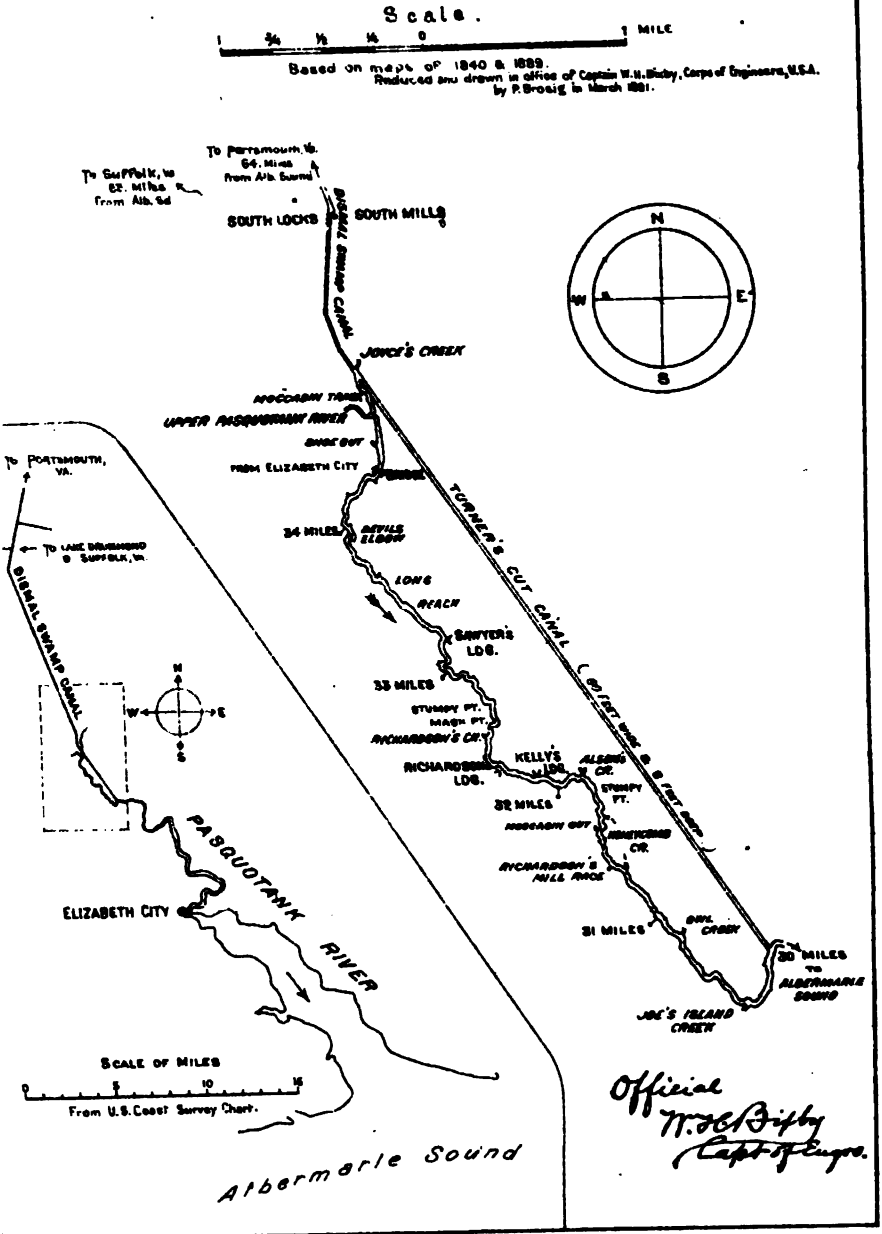
(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original project, so as to secure a thoroughly cleared 9-foot navigation to the lower end of Turner's Cut, and thence a similar 5-foot navigation to the upper end of this cut, and thence a thoroughly cleared channel of natural width and depth 6 miles farther to Lebanon Bridge, at a total expense of $6,000 in addition to the funds available 30th of June, 1891; this amount to be appropriated in a single sum. Smaller yearly appropriations, involving

PASQUOTANK RIVER, N.C.

UPPER PORTION OF RIVER

BETWEEN

THE ENDS OF TURNER'S CUT.



Based on maps of 1840 & 1889.
Reduced and drawn in office of Captain W. H. Bixby, Corps of Engineers, U.S.A.
by P. Brosig in March 1891.

From U.S. Coast Survey Chart.

Official
W. H. Bixby
Capt. of Engrs.

the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and the deterioration of plant, may increase the cost of the work by from $1,500 to $2,500 per appropriation. Further improvement to increase the depths or extent of river to be improved is not recommended at present.

After the improvement is finished its proper maintenance may cost from $1,000 to $2,000 per year.

This river is in the collection district of Albemarle, and the nearest port of entry is Edenton, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$3,000.00
June 30, 1891, amount expended during fiscal year	2,277.70
July 1, 1891, balance unexpended	722.30
July 1, 1891, outstanding liabilities	62.58
July 1, 1891, balance available	659.72
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. CHARLES SCHUSTER, OVERSEER.

UNITED STATES ENGINEER OFFICE,
Scotland Neck, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of work done under my charge on the Upper Pasquotank River and Moccasin Track, North Carolina:

Under your orders dated December 29, 1890, $2,200 were authorized to be expended on this work in the following manner:

Moccasin Track to be cleared to its full natural width, not to exceed 60 feet. Afterward the remaining funds to be spent in securing, as far as possible, a similar channel way on the rest of the river between the ends of Turner's Cut.

After a preliminary survey of the proposed field of operation the necessary plant, consisting of one hoister, one flat, tools, rope, etc., was towed from Roanoke River, North Carolina, to Pasquotank River by United States steamer *H. G. Wright*, January 10 to 16, and the work of clearing the channel at Moccasin Track was started January 18, 1891.

The following obstructions were removed: 471 large snags, 342 sunken logs, 801 stumps, 9 cords of small snags, 65 overhanging trees cut and hauled back, and one wreck removed.

The extraordinary large dimensions of the stumps removed necessitated the liberal use of explosives. Eight hundred and sixty-five pounds of rackarock have been used for the 228 blasts fired, and the almost constant use of the grappling hook was necessary to remove the roots and fragments from the river bottom, but owing to the loose, peaty, and sandy bottom the work of hoisting was comparatively easy.

Peter A. Nelson, suboverseer, who was in immediate charge of the work, is to be complimented on the practical judgment used and efficient services rendered.

The actual work in field was closed for lack of funds April 16, 1891, and the hoister started for Roanoke River under her own steam by means of side wheels, and after stopping at Elizabeth City and Edenton for coal, arrived at Edwards Ferry, Roanoke River, April 25, 1891.

Gauge observations have been taken daily since February 1, 1891.

A detailed survey of Moccasin Track was made in April, 1891. A further appropriation of $12,000 is needed to complete work on this river; this amount to be distributed as follows: For dredging a channel 50 feet wide and 10 feet deep through Moccasin Track, $6,000; to remove snags, stumps, and overhanging trees from channel of Pasquotank River from juncture of Moccasin Track and Pasquotank River to Bight's Bridge, 3¼ miles, $2,000; and to remove snags, stumps, and overhanging trees from channel of Pasquotank River from Richardson's Mill Race (1½ miles above lower mouth of Turners Cut) to 6 miles below Turners Cut, $4,000.

The result of the work done is that canal barges now pass direct from Norfolk, Va., to Elizabeth City, N. C., and already a steamer 60 feet long by 13 feet wide is making semiweekly trips between the places named.

The expenses were:

For towage	$5.10
For channel work	2,103.43
For bank work	11.70
Total	2,120.23
Amount authorized	2,200.00
Balance on hand	79.79

Very respectfully, your obedient servant,

CHAS. SCHUSTER,
Overseer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

This improvement was not commenced before the 31st December, 1890. At that time the annual commerce was estimated at about $900,000, passing up the river from Elizabeth City to the Dismal Swamp Canal and Norfolk.

The portion of the river under improvement forms a part of the present boat route from Elizabeth City to Norfolk, avoiding the bad shoals of the southern extension of the canal.

The present actual annual commerce remains the same as in December, 1890, the actual improvement of this waterway being only just commenced. Two lines of steamers make regular trips over the river from Elizabeth City to Norfolk, Va.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$41,115		$41,115	260
Tobacco		$2,000	2,000	5
Rice	1,100		1,100	40
Grains and forage	26,975	6,000	32,975	1,320
Vegetables and truck	940		940	10
Live stock and products	4,600		4,600	75
Fish, oysters, &c	256,820		256,820	6,300
Naval stores	750		750	50
Lumber and products	457,700		457,700	140,000
Coal and minerals		5,500	5,500	900
Fertilizers		4,040	4,040	200
General merchandise		87,960	87,960	800
Sundries		4,500	4,500	40
Total	790,000	110,000	900,000	150,000

Gain over last year, nothing.

Transportation lines established during year, none.

The work of improvements did not commence until 1891.

The above statistics are based mainly upon reports of Capt. W. H. Bixby, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

The commerce at present, as above shown, is 150,000 tons, $900,000; expended on improvement up to 31st December, 1890, $170.

L 4.

IMPROVEMENT OF MACKEY CREEK, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of this water way see pages 1137–1139 of Annual Report for 1889. (For map of portion improved see end of the present report.)

(2) *Original condition.*—Mackey Creek has a total length of about 20 miles and a drainage basin of about 100 square miles. The portion under improvement is its mouth where it empties into Albemarle Sound.

When placed under governmental improvement in 1890 the lower half mile of this stream formed a fine harborage for boats of 12 feet depth, and was utilized as a railroad terminus for the country between Albemarle and Pamlico Sounds. The exit from the creek across its bar was crooked and only from 5 to 7 feet deep at low water, interfering greatly with steamboat service to and from the railroad. Its commerce was then estimated at about $607,000.

(3) *Plan of improvement.*—The original project of 1889, as continued to date, proposed to secure a straight channel of 100 feet width and 9 feet depth at low water from the creek across the bar to Albemarle Sound.

The total final cost of such work was estimated in 1889 to be $15,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $15,000.

(4) *Results.*—Up to June, 30, 1890, no funds had been voted and no work done. No results can be expected before 1892. The navigation of this creek is not obstructed by bridges within the half mile under improvement.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $359.48; value of United States plant, nothing.

Project for this improvement was approved in October, 1890, all the available funds to be spent for dredging, including water-gauge observations, surveys, office and minor work; the dredging to be done by contract, and all superintendence, minor, and other work to be allowably done by hired labor and purchase of materials in open market.

In November and December, 1891, the area where dredging was to be done was carefully surveyed and mapped, and the exact location of the dredging was determined upon. This work was well done by Assistant Engineer Charles Humphreys.

Contract for dredging was approved in April, 1891, with the Alabama Dredging and Jetty Company, of Mobile, Ala., to be commenced in October, 1891, and finished in May, 1892.

The latest reliable commercial statistics, those for the year ending December 31, 1888, are herewith appended, showing a commerce of about $607,100 (about 32,410 tons) per year.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original project, so as to secure a straight channel of 100 feet width and 9 feet depth at low water from the creek into Albemarle Sound, by means of the funds already on hand. No further improvement is recommended.

The channel once thoroughly opened should remain tolerably permanent.

This water-way is in the collection district of Albemarle, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890		$15,000.00
June 30, 1891, amount expended during fiscal year		349.48
July 1, 1891, balance unexpended		14,650.52
July 1, 1891, outstanding liabilities	$10.00	
July 1, 1891, amount covered by uncompleted contracts	14,000.00	
		14,010.00
July 1, 1891, balance available		640.52

Abstract of proposals for dredging, opened at 11 o'clock a. m. March 11, 1891, by Capt. W. H. Bixby, Corps of Engineers.

There is $14,700 available for work on this improvement.
Proposals invited for from $12,000 to $14,000 worth of work.

No.	Name and address of bidder.	Price bid per cubic yard.
1	P. Sanford Ross, Jersey City, N. J	49 cents in scow.
2	Alabama Dredging and Jetty Company, Mobile	26 cents in scow.
3	Chester T. Caler, Norfolk, Va	29½ cents in scow. 34½ cents in situ.*

* 34½ cents in situ equals 27.6 cents in scows according to specifications.

Awarded to bidder No. 2, The Alabama Dredging and Jetty Company.

COMMERCIAL STATISTICS.

This improvement was not commenced before the 31st of December, 1890. At that time, the annual commerce was estimated at about $607,000, being limited to boats of about 5 to 7 feet draft.

The present appropriation will probably open a channel of 8 to 9 feet draft and the commerce will probably rapidly develop to over $1,000,000.

The present actual commerce remains about the same as in December, 1890, the actual improvement of this water way not being yet commenced.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$100,000		$100,000	500
Grains and forage	27,500		27,500	850
Vegetables and truck	12,000		12,000	1,500
Live stock and products	10,000		10,000	20
Fish, oysters, etc	1,600		1,600	40
Lumber and products	256,000		256,000	28,500
General merchandise		$200,000	200,000	1,000
Total	407,100	200,000	607,100	32,410

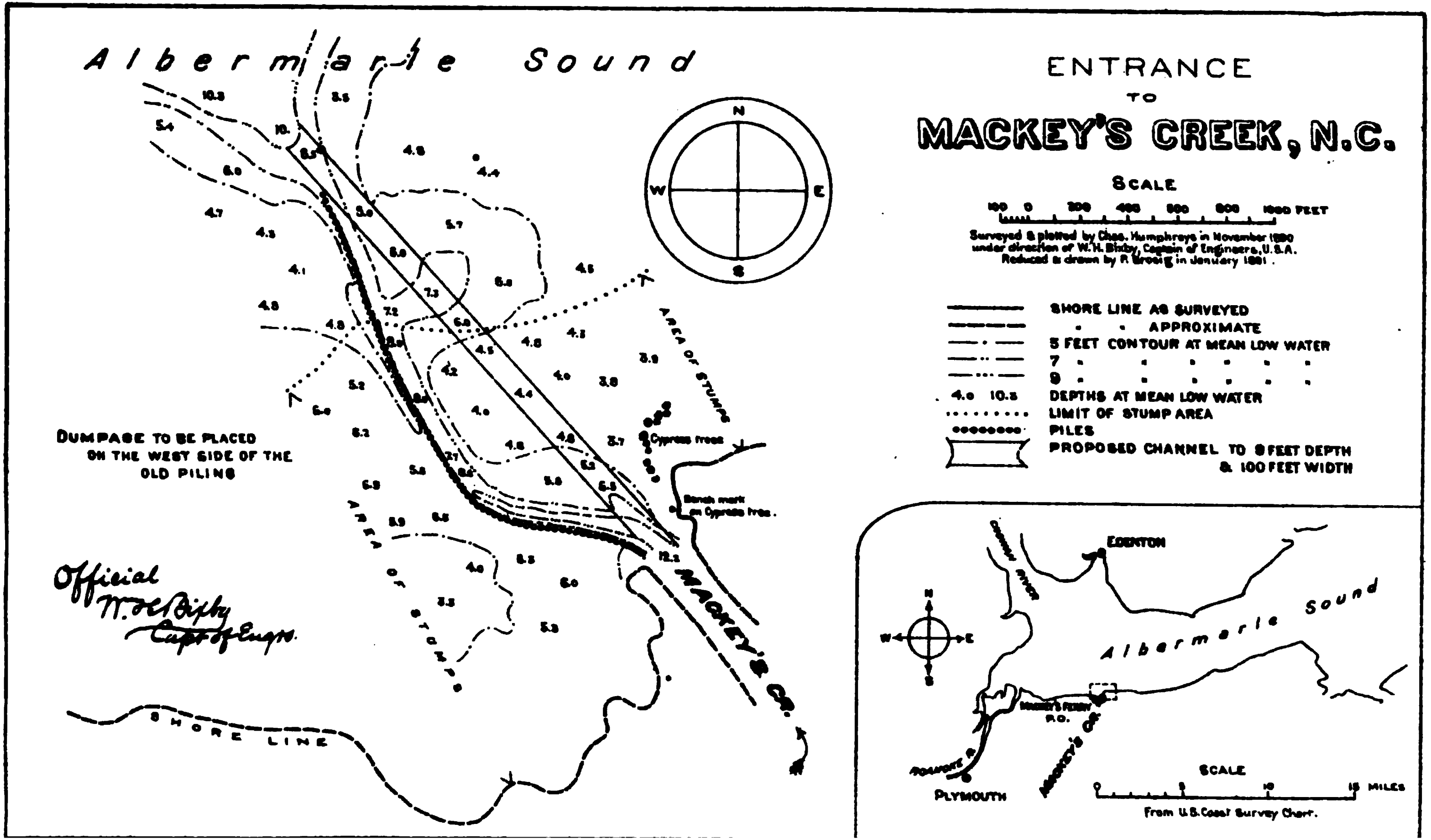
Gain over last year, none.

Transportation lines established during year, none.

The work of improvement will not commence before 1891.

The above statistics are based mainly upon reports of Capt. W. H. Bixby, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

The commerce at present, as above shown, is 32,410 tons, $607,100; expended on improvement up to December 31, 1890, for surveys only, $275.



ENTRANCE
TO
MACKEY'S CREEK, N.C.

Surveyed & plotted by Chas. Humphreys in November 1880
under direction of W. H. Bixby, Captain of Engineers, U.S.A.
Reduced & drawn by F. Grosig in January 1881.

DUMPAGE TO BE PLACED
ON THE WEST SIDE OF THE
OLD PILING

Official
W. H. Bixby
Capt. of Engrs.

From U.S. Coast Survey Chart.

L 5.

IMPROVEMENT OF OCRACOKE INLET, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of this water way, see pages 1118–1124 of Annual Report of 1889. (For maps of portion improved, see end of the present report.)

(2) *Original condition.*—Ocracoke Inlet is one of the main ocean outlets of Pamlico and Albemarle Sounds, and derives its importance from that fact. When placed under governmental improvement in 1890, it had a good bar entrance from the ocean carrying from 12 to 15 feet depth and two bar entrances to Pamlico Sound carrying from 4 to 6 feet depth. The commerce was limited to occasional 6-foot draft steamers, and to occasional schooners and small ships, the latter stopping just within the inlet at its small towns, Portsmouth and Ocracoke. The commerce was then estimated at about $100,000.

(3) *Plan of improvement.*—The original project of 1889, as continued to date, proposed to improve the southern bar passage (called Portsmouth Straightway) into the sound by dredging a channel of 300 feet width and from 10 to 15 feet depth across this bar, so as to make the passage from the inlet harborage into Pamlico Sound as good as the passage from the harborage out into the ocean.

The total final cost of such work was estimated in 1889 to be $600,000.

The aggregate amount appropriated for this project up to the 30th of June, 1891, is $90.000.

(4) *Results.*—Up to the 30th of June, 1890, no funds had been voted and no work was done. No results can be expected before 1892.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $1,747.71; value of United States plant, $30.

Project for this work was approved in October, 1890; all the available funds to be spent for dredging, including necessary surveys, water-gauge observations, office and minor work; the dredging to be done by contract, but all other work to be allowably done by hired labor and purchase of materials in open market.

In January to May, 1891, a survey of the inlet was well made by Lieut. Mason M. Patrick, whose report and maps are herewith appended. Exceedingly bad weather caused much delay in this work. This survey afforded all information deemed necessary for the definite location of the proposed channel.

One water gauge was kept during the last part of the year. Preparations were made in June for letting this work out by contract.

The latest reliable commercial statistics, those for the year ending 31st of December, 1888, are herewith appended, showing a commerce of about $100,000 (about 1,500 tons) per year.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original project, so as to secure a channel of 300 feet width and from 10 to 15 feet depth at low water from Pamlico Sound to the ocean, at a total expense of $510,000, in addition to the funds available 30th of June, 1891, this amount to be appropriated at the rate of $100,000 or more per year.

Smaller or irregularly voted appropriations will do a certain amount of good, but they will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of unfinished parts of the channel, and extra cost of moving plant over long distances to and from the place of work, and may increase the final cost of the work by from $4,000 to $8,000 per appropriation.

The channel, once thoroughly opened and diked, should remain fairly permanent.

This water-way is in the collection district of Pamlico, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$90,000.00
June 30, 1891, amount expended during fiscal year	1,725.71
July 1, 1891, balance unexpended	88,274.29
July 1, 1891, outstanding liabilities	22.00
July 1, 1891, balance available	88,252.29
Amount (estimated) required for completion of existing project	510,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF LIEUTENANT MASON M. PATRICK, CORPS OF ENGINEERS, ON DETAILED SURVEY OF OCRACOKE INLET, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., May 5, 1891.

CAPTAIN: I have the honor to submit the accompanying maps and the following report upon a survey of Ocracoke Inlet, North Carolina, made in compliance with the following orders:

"UNITED STATES ENGINEER OFFICE,
"*Wilmington, N. C., January 6, 1891.*

"SIR: You will proceed from Wilmington to Ocracoke Inlet and make a survey of that inlet so far as to give the information necessary for preparing a project for its improvement in the manner outlined by me in the last Annual Report of the Chief of Engineers.

"The cost of this survey in the field will be limited to $2,800.

"You will accompany your report on this survey by a general map of the inlet on a scale of an inch to 2,000 feet, and by a detailed map of the portion in which dredged channels may have to be located on a scale of an inch to 400 feet. The general map will show shore lines and the axis of all the channels over 9 feet deep at low water, and the axis of all shoals less than 6 feet deep at low water, with soundings at about 500-foot intervals along these axes, and with soundings in lines normal to these axes, these latter lines being about 1,000 feet apart, and their soundings being so spaced as to approximately locate the 3, 6, 9, 12, 15, 18, 24, 36 feet contours below water.

"The prominent points of the shore lines should be located to within at least 25 feet of their true position. The rest of the shore lines can be run in if desirable by pacing and pocket compass. The location of points of soundings should be within at least 100 feet of their true position, and the width of channels between steep banks should be within 10 per cent. Special pains should be taken to locate all pockets suitable for dumpage basins.

* * * * * * *

"Very respectfully, your obedient servant,

"W. H. BIXBY,
"*Captain, Corps of Engineers.*

"Lieut. MASON M. PATRICK,
"*Corps of Engineers, U. S. A.*"

The party left Beaufort, N. C., on 22d of January, 1891, and reached their destination 23d January at 10 p. m. For use in making this survey we had one naphtha launch, one sharpie, and one yawl boat.

FIELD WORK.

After carefully looking over the ground a site was selected on the beach on the west side of the inlet, where a base line was measured 8,096 feet long. This measurement was made with a 100-foot "silverine" tape, the measurement being repeated and a mean of the two taken as the true length of the base.

Due care was taken in making this measurement, and it is believed that the length taken, 8,096 feet, is as nearly correct as the needs of the survey demanded; extreme accuracy was not sought, nor was it desired.

Triangulation stations were selected so as to fully cover the area to be surveyed, and all the angles of each triangle were read; as many check readings as possible were also taken from each station.

Such topography, shore lines, etc., as were necessary were run in by compass bearings and stadia distances.

A quick but thorough examination was then made of all the channels within the limits of the survey in the following manner: Two convenient triangulation stations were selected; at each an observer was located with a transit; soundings were then taken from the naphtha launch; the position of the launch was located every 2 minutes, a flag being displayed in the launch about 10 or 15 seconds before the expiration of every 2 minutes, and then at the end of the two minutes the flag was lowered; both transits were kept on the flag until it was lowered, they were then read and the reading recorded. In running any channel the launch would zigzag from one side to the other, going as close as possible to the shoals on either side, the time of each turn being carefully noted by the recorder in the boat.

This work being plotted, a good idea was obtained of the condition and positions of the channels and shoals, and those places where more careful examinations would be needed were readily determined.

A favorable opportunity occuring, a number of soundings were taken out the Main Bar Channel, the same method as above being followed. These soundings show the Bar Channel to be wide, fairly straight, and with a least depth of not less than 15 feet at mean low water.

After this general survey attention was given mainly to the Southwest or Wallace Channel, the one selected and recommended for improvement in your report mentioned in the above order. Over this channel lines of soundings were taken about 1,000 feet apart, and in addition more careful examinations were made of the following localities (see maps):

(1) Near the "Red Spar Buoy" lines of soundings were taken about 500 feet apart for the purpose of showing the bulkhead which seems to have made across the channel here. This bulkhead is part of the middle-ground shoal, and the least depth on it in mid-channel is 9 feet at mean low water; the width between the 12 feet contours is about 2,000 feet.

(2) Over the area beyond "Flounder Slough Rock" and "Mount Vernon Rock," extending across the shoal between the head of Wallace Channel and the deep water of Royal Shoal Harbor, lines of soundings were taken 500 feet apart. Somewhere within this area the dredging to connect Wallace Channel and Royal Shoal Harbor will have to be done, and these soundings show very clearly the contours of the bottom.

Soundings were taken over the whole area of Royal Shoal Harbor, outlining it very clearly.

All soundings on the map are reduced to mean low water.

For location and description of bench marks see maps.

TIDAL OBSERVATIONS.

Immediately upon arriving at the inlet a tide gauge was set up and was read daily at high and low water; as soon as possible an automatic tide gauge was put in position, and a continuous record kept from 10th February to the morning of the 12th of April, 1891. The reading of +2.0 feet on the gauge was assumed as mean low water. A mean of all low-water readings recorded, 72 in number, gives for mean low water during the time of the survey a reading on the gauge of 2.45 feet.

To obtain an idea of the rise and fall of the tide at different points and the relative time of high and low water tide gauges were established at the following points (see map): (1) Near Ocracoke Point; (2) near Portsmouth Point; (3) near "Black Spar Buoy, sanded up;" (4) automatic gauge near "Hawlover Point;" (5) at "Flounder Slough Rock;" (6) on the shoal near the head of Wallace Channel.

These gauges were read every 10 minutes, and the following table gives a few of these readings, each gauge being supposed to read +2.0 feet at mean low water:

Reading of gauges and surface velocity of water at stated points, taken on April 10, 1891.

Time of day.	Ocracoke Point.	Velocity per hour.	Portsmouth Point.	Velocity per hour.	Black Spur Buoy.	Flounder Slough Rock.	Haulover Point.	Head of Wallace Channel.	Velocity per hour.
		Miles.		*Miles.*					*Miles.*
7 a. m.	....	....	4.35	....	....	....	+ 3.10	....	....
7:20 a. m.	....	....	4.40	....	....	....	3.10	....	....
7:40 a. m.	....	....	4.50	....	....	....	3.15	2.53	....
8 a. m.	....	....	4.55	....	....	2.8	3.20	2.53	0.37
8:20 a. m.	....	....	4.50	....	4.47	2.8	3.20	2.53	....
8:40 a. m.	....	....	4.40	....	4.32	2.8	3.15	2.48	0.30
9 a. m.	4.75	....	4.25	....	4.12	2.7	3.10	2.43	....
9:20 a. m.	4.65	....	4.05	....	3.92	2.7	3.00	2.38	0.12
9:40 a. m.	4.45	....	3.90	....	3.72	2.65	2.95	2.38	....
10 a. m.	4.20	....	3.75	....	3.62	2.65	2.85	2.33	0.00
10:20 a. m.	4.00	....	3.65	....	3.52	2.60	2.80	2.33	....
10:40 a. m.	3.80	....	3.50	....	3.37	2.50	2.75	2.33	0.00
11 a. m.	3.60	....	3.40	....	3.32	2.40	2.70	2.28	....
11:20 a. m.	3.40	....	3.20	1.5	3.12	2.40	2.60	2.28	....
11:40 a. m.	3.20	....	3.10	1.5	3.02	2.30	2.55	2.23	+0.25
12 m.	3.05	2.0	2.95	1.5	2.82	2.30	2.50	2.23	....
12:20 p. m.	2.95	....	2.85	1.5	2.72	2.30	2.45	2.23	0.25
12:40 p. m.	2.80	....	2.75	1.5	2.62	2.30	2.40	2.23	....
1 p. m.	2.70	....	2.67	1.5	2.62	2.20	2.40	2.23	0.34
1:20 p. m.	2.70	2.0	2.66	....	2.57	2.20	2.40	2.23	....
1:40 p. m.	2.70	....	2.65	....	2.62	2.20	2.35	2.18	0.37
2 p. m.	....	....	2.65	....	....	2.20	2.30	2.18	0.50
2:20 p. m.	....	....	2.70	....	....	2.20	2.30	2.13	0.37
2:40 p. m.	....	....	....	....	....	....	....	2.18	0.30

A number of borings were taken and their positions are plotted on the map. These borings indicated the presence of nothing not readily moved by running water, the material being sand, with possibly some few shells. The borings were taken to a depth of 19 feet below the surface of the water.

The field work was completed on the 11th of April, 1891, and the party left for Beaufort, N. C., and Wilmington the following day.

I wish to call attention to the great advantage which the naphtha launch was to us in this survey. Nearly all our sounding was done from her; her speed was found to be very uniform; soundings were readily taken and read, while she provided ample room for all the sounding party. To have done from a rowboat the amount of sounding which was done from this launch would, in my opinion, have taken at the least calculation three times as long and would have been much more expensive.

I have to thank Messrs. S. F. Burbank, surveyor, and John A. Dill, overseer, for cheerfully rendered and very efficient assistance in carrying on the work of this survey.

The entire expense of the survey was $1,707.71, which would have been considerably less if it had not been for the fact that the field work was much retarded by exceedingly bad weather, only 28 days out of 63 being such as would allow work on the water.

Respectfully submitted.

MASON M. PATRICK,
First Lieut. of Engineers.

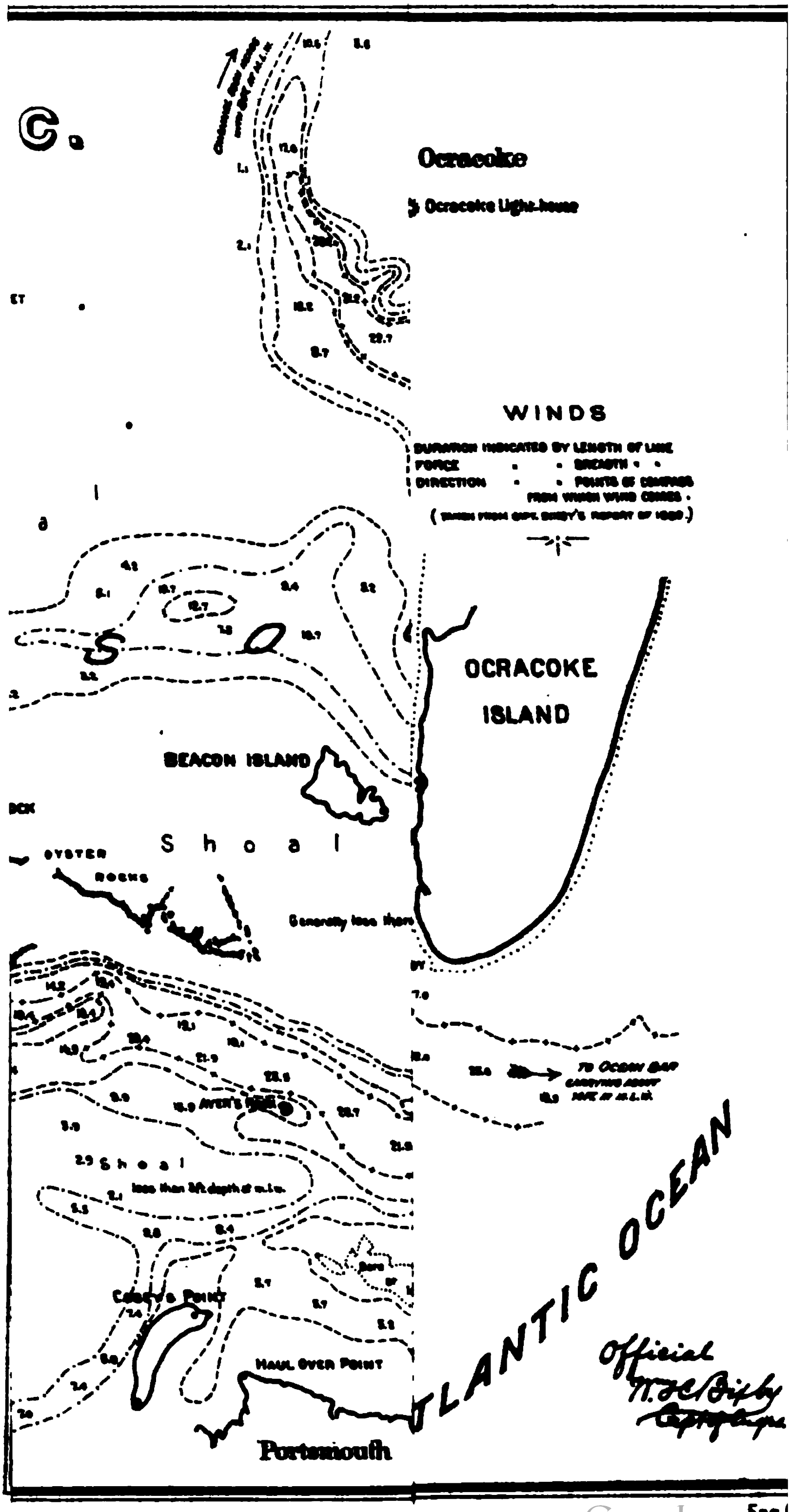
Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

This improvement was not commenced before December 31, 1890. At that time the annual commerce is estimated to have been less than $100,000, being limited to that of small sailing craft of less than 7 feet draft, plying between Albemarle and Pamlico Sounds and Southern ports.

Two appropriations of $200,000 each will open a passage of 13 feet depth of channel across the sound bar of this inlet and will make the inlet the natural passage for a large part of the existing $7,000,000 of commerce of the Neuse and Pamlico Rivers, and will probably rapidly develop a few additional millions of similar commerce between all parts of Pamlico and Albemarle Sounds and other States.

The present commerce remains the same as that of December 31, 1890, estimated at $100,000, or 15,000 tons; the improvement of this water-way being only just commenced.


Ocracoke
Ocracoke Light-house
WINDS
DURATION INDICATED BY LENGTH OF LINE
FORCE " " BREADTH " "
DIRECTION " " POINTS OF COMPASS FROM WHICH WIND COMES.
(TAKEN FROM CAPT. BIXBY'S REPORT OF [illegible])
OCRACOKE ISLAND
BEACON ISLAND
Shoal
OYSTER ROCKS
Generally less than
TO OCEAN BAR CARRYING ABOUT
AT M.L.W.
ATLANTIC OCEAN
Shoal
less than 3 ft. depth at m.l.w.
Casey's Point
Haul Over Point
Portsmouth
Official
W. H. Bixby
Capt. of Engrs.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Tonnage.
Live stock and products	$500	....
Fish, oysters, etc	6,800	....
Sundries	2,000	....
Total	9,300	15,000

Gain over last year, none, the improvements having just commenced.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Capt. W. H. Bixby, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

The commerce at present, as above shown, is 15,000 tons, $9,300.

L 6.

IMPROVEMENT OF FISHING CREEK, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of this water way see pages 1179–1181 of Annual Report of 1890.

(2) *Original condition.*—Fishing Creek is a stream of about 120 miles total length and about 760 square miles of drainage area. The portion under improvement is its lower 38 miles, from Bellamy Mill, Enfield, down to its mouth, in the Tar River.

When placed under governmental improvement, in 1890, this stream was badly obstructed over its entire length by very numerous snags and fallen trees in its channel and by leaning and overhanging trees on its banks, entirely obstructing any regular navigation. Its river commerce, therefore, was practically nothing.

(3) *Plan of improvement.*—The original project of 1889, as continued to date, proposed to clear out all the natural obstructions in the river up to Bellamy Mill, such as snags, fallen trees, leaning trees, overhanging trees, etc.

The total final cost of this work was estimated in 1889 at $25,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $10,000.

(4) *Results.*—Up to the 30th of June, 1890, no funds had been voted and no work done. No results can be expected before 1892. The navigation of this water way is obstructed by ten bridges; but where such obstruction is an unreasonable one the bridge owners have promised to insert draws as soon as funds are available enough to carry the improvement up to such bridges.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the past year is as follows: Expenditures, nothing. Value of United States plant, nothing.

Project for this improvement was approved in October, 1890; all the available funds to be spent in snagging and bank trimming, including the cutting off of projecting points of banks at sharp bends, occasional blasting, surveys, water-gauge observations, and office and minor work; no funds to be spent until the obstructing bridges have all been withdrawn, removed, or provided with draws.

In November, and subsequently, action was taken to secure draws in all the bridges, but without success. One county bridge and a railroad bridge close to Bellamy Mills, while obstructions to a certain extent, do not appear to be "unreasonable obstructions," such as are removable by law under the last river and harbor act, and their owners do not care to go to the apparently unreasonable expense of inserting draws therein. The owners of the other eight bridges on the lower river are ready to insert draws at any time, if by so doing the funds now available can be spent immediately. The provisions of the special appropriation for this stream forbid any expenditure till draws are inserted in all obstructing bridges (which includes the railroad bridge). The provisions of the general river and harbor bill provide no means of forcing the construction of this draw, since the obstruction of this bridge is not "unreasonable." The railroad owners apparently will not insert the draw voluntarily. Consequently all active work remains suspended to await further action of Congress. This delay is the more to be regretted inasmuch as the present funds are not enough to clear but a portion of the lower river, and all bridge owners upon this portion are ready to insert draws in their bridges.

The river not being yet open to navigation, has consequently no present commerce.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original project, so as to secure a well-cleaned channel of natural width and depth up to Bellamy Mill, at a total expense of $15,000 in addition to the funds available 30th of June, 1891; and it is *specially recommended* that the existing *restrictions*, as to the expenditure of the present and all future funds, be so *modified* as to require *draws only in* such bridges as, in the opinion of the officer in charge, are *unreasonable obstructions* to the river navigation. For economical work, these funds should be voted in yearly installments of about $10,000 per year. Smaller or irregularly voted appropriations will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of plant, and extra cost of moving plant over long distances to and from the place of work, and may increase the final cost of the work from $1,000 to $3,000 per appropriation.

After the river is once thoroughly cleared, its proper maintenance may cost from $1,000 to $2,000 per year.

This water-way is in the collection district of Pamlico, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000
July 1, 1891, balance unexpended	10,000
Amount (estimated) required for completion of existing project	15,000
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

This improvement was not commenced before the 31st of December, 1890. At that time the annual commerce was nothing, because the river was so blocked up by overhanging, fallen, and sunken trees, by snags, and by the shoals caused thereby.

Two appropriations of about $12,000 each would clear out this river sufficiently to allow the passage of boats of 4 feet draft at average water, opening up a region of from 40,000 to 120,000 acres of good farming lands, with an already actual trade of $900,000 and a possible commerce of from $2,000,000 to $5,000,000 per year.

The present actual river commerce remains the same as that of December 31, 1890, viz, nothing, the actual improvement of this water-way not yet being commenced.

L 7.

IMPROVEMENT OF PAMLICO AND TAR RIVERS, INCLUDING TAR RIVER FROM TARBORO TO LITTLE FALLS, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of Pamlico River, see pages 361–363, Annual Report for 1876, and pages 1130–1132, Annual Report for 1889; for history of work, see pages 649–651, Annual Report for 1879; and for map of river, see page 836, Annual Report for 1880, and page 1114 of Annual Report for 1890. For special description of Tar River, see pages 700–702, Annual Report for 1879; and for map of river, see page 1114, Annual Report for 1890.

For special description of the river above Tarboro, see pages 1130–1132, Annual Report for 1889, and for its map, see this present report.

(2) *Original condition.*—The Pamlico and Tar rivers are different portions of a single stream, the upper portion being called the Tar. The Tar has a total length of about 180 miles and a drainage area of 3,200 square miles, and changes its name to the Pamlico at the town of Washington, N. C. The Pamlico has a further length of about 37 miles and a further drainage area of 1,700 square miles, and finally widens out into Pamlico Sound. The combined rivers, therefore, have a total length of about 217 miles and a total drainage area of about 4,900 square miles.

When placed under governmental improvement in 1876, the Pamlico River had an available depth of only 3 feet at low water in its upper portion near Washington; thence the Tar River had, during 8 months of the year, an available depth of from 2 to 3 feet for 48 miles, up to Tarboro, its practicable limit of navigation; but the channel of the combined stream was almost completely obstructed by two war blockades and by floating and sunken stumps and logs, and by overhanging trees. Its steamboat commerce is now estimated to have then been about $500,000.

(3) *Plan of improvement.*—The two rivers have been considered by Congress, separately prior to 1880, but jointly ever since then. The original project of 1876 (for the Pamlico) and of 1879 and 1889 (for the Tar), as since slightly modified and continued to date, proposed to secure a clear and safe channel 9 feet deep at low water up to Washington; thence a channel 60 feet wide and 3 feet deep at low water for 22 miles farther to Greenville; and thence a channel 60 feet wide and 20 inches deep at low water for 26 miles farther to Tarboro, and thence 32 miles farther to Rocky Mount Little Falls. A personal inspection of the river in 1886 showed the agricultural richness of the river basin, its need of water transportation, and the worthiness of the improvement.

The total final cost of this work was estimated in 1889 to be $92,200.

The total amount appropriated for these projects up to June 30, 1891, is $78,000.

The funds on hand will be used up before new appropriations ca become available.

(4) *Results.*—Up to June 30, 1890, a total of $66,227.90, including outstanding liabilities, had been spent in all upon this improvement; i securing a good channel at least 9 feet deep at low water and at least 108 feet wide from Pamlico Sound up to Washington; thence a fair channel 60 feet wide and 3 feet deep all the year to Greenville; and thence a similar channel 8 months of the year to Tarboro.

In consequence of this 13 steamers ran regularly to Washington, thence 4 steamers ran 3 times a week all the year to Greenville, and 8 months of the year to Tarboro. The present commerce was rapidly increasing and was then about $4,600,000 of goods transported per year, showing that each dollar once spent upon this improvement had been accompanied by a development of about $64 in annual commerce. Besides this, the rates of freight are estimated to have been lowered between 12 and 50 per cent. since the commencement of the improvement.

The navigation of this river was not obstructed by bridges without draws below Tarboro.

Bridges above Tarboro will probably be provided with draws as soon as the river is well cleared of its obstructions.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the past year is as follows: Expenditures, $2,565.23, including outstanding liabilities; value of plant, $1,545.

Owing to the difficulty of properly specifying it beforehand and measuring it afterwards, all work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

Active work was suspended in June, 1889, to await more funds and a more favorable stage of water for snagging.

While not needed on this river, its United States property was used for a time on the Neuse River, and then stored and cared for on that stream.

The river from Tarboro to Rocky Mount Little Falls was surveyed and mapped.

Mile posts were established over the entire length of river to serve as points of reference in reporting obstructions and laying out work.

The river at and just below Washington was surveyed with reference to securing a better channel below Washington (see map herewith, and see also special report further on marked Appendix 28). The results of this survey show $45,000 more of work necessary below Washington to obtain the depths of the original approved project of 1879 and following years.

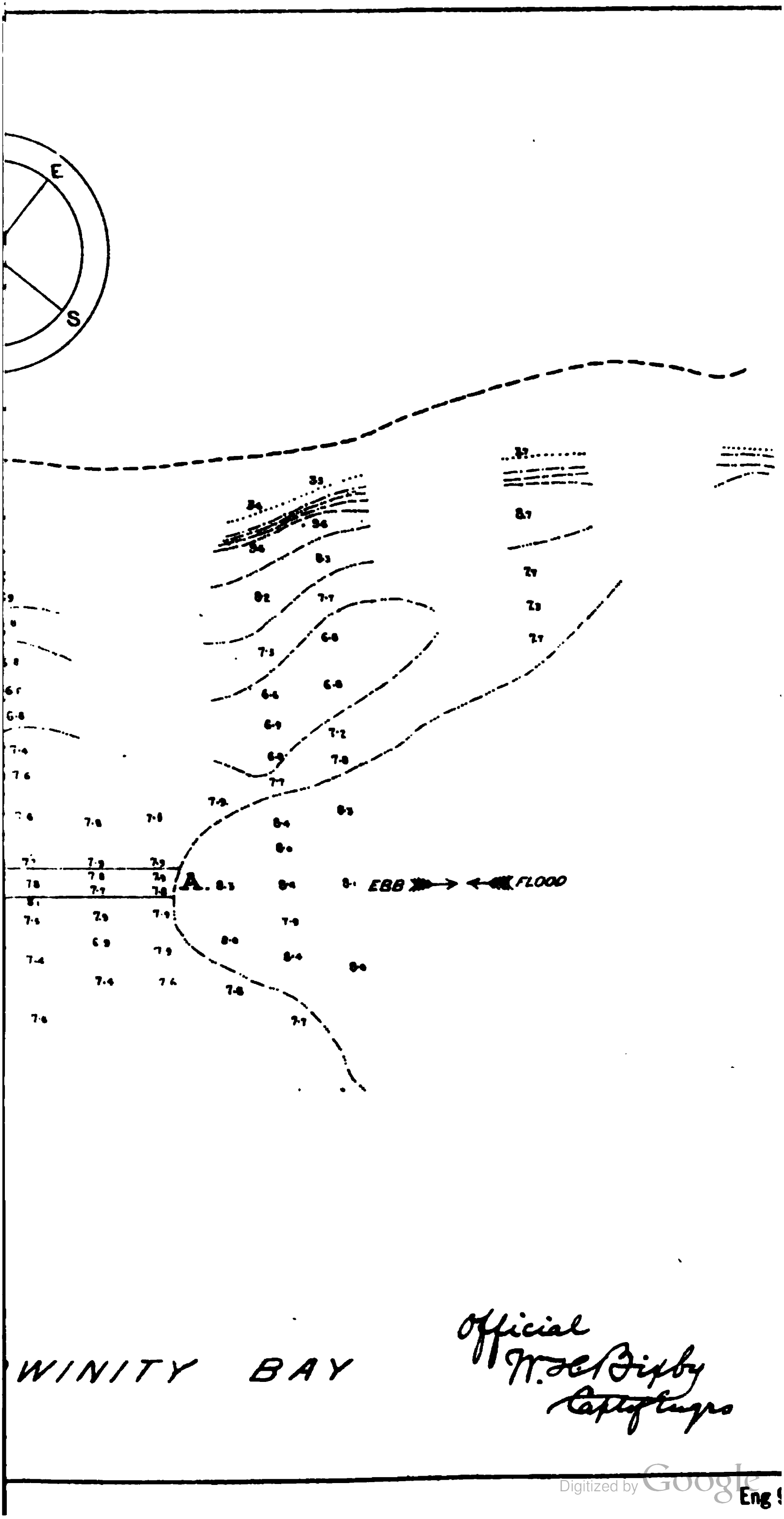
Four water-gauges have been kept during the year.

Inspections of plant and work have been made during the year.

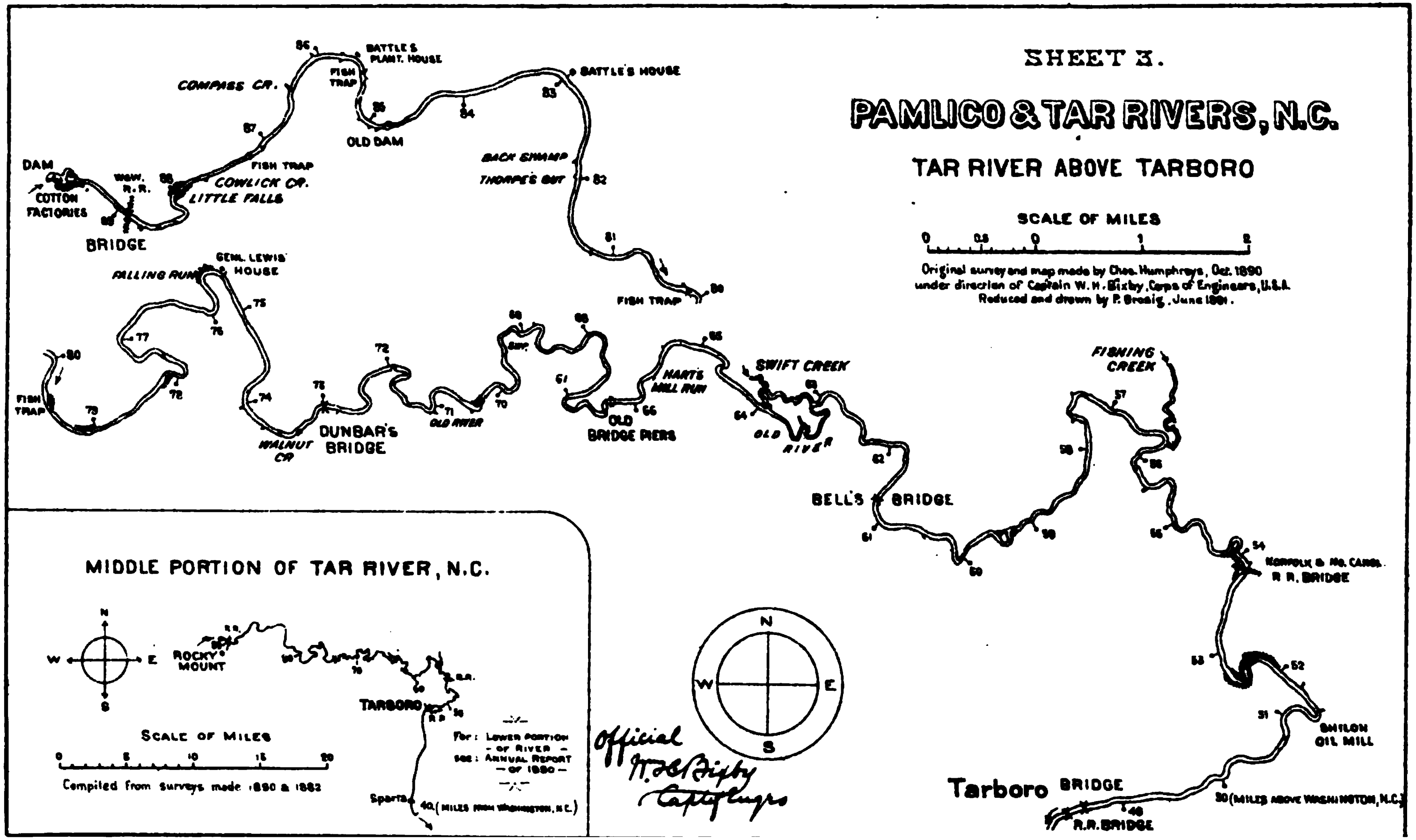
This improvement has been under the immediate supervision of Superintendent R. Ransom, whose report is herewith appended.

The existing fair navigable condition of the river below Tarboro has been maintained, and the 23 miles of the river above Tarboro heretofore opened have been used by steamers of 3-foot draft during 8 or 9 months of the year. The river commerce is steadily increasing. Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending



Official
W. H. Bixby
Capt of Engrs



SHEET 3.

PAMLICO & TAR RIVERS, N.C.

TAR RIVER ABOVE TARBORO

SCALE OF MILES

Original survey and map made by Chas. Humphreys, Oct. 1890
under direction of Captain W. H. Bixby, Corps of Engineers, U.S.A.
Reduced and drawn by P. Brosig, June 1891.

MIDDLE PORTION OF TAR RIVER, N.C.

SCALE OF MILES

Compiled from surveys made 1880 & 1882

For: LOWER PORTION OF RIVER
see: ANNUAL REPORT OF 1890

Official
W. H. Bixby
Capt. Engrs.

December 31, 1890, are herewith appended, showing a commerce of $6,742,475 per year (about 277,832 tons).

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the present proposed and approved project, so as to secure a thoroughly cleared 9-foot navigation at low water up to Washington ($45,000, see appendix 28), a similar 3-foot navigation at low water up to Greenville, and thence a similar 3-foot channel during 8 months of the year up to Rocky Mount Little Falls, at a total expense of $59,200, in addition to the funds available June 30, 1891, this amount to be appropriated in yearly installments of as much as $30,000 until finished. Smaller appropriations may increase the cost by from $1,000 to $3,000 per year. Further improvement so as to extend this navigation above Rocky Mount Little Falls, or to make the river above Greenville navigable all the year round, is not recommended at present.

After the improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

This river is in the collection district of Pamlico, N. C.

Money statement.

July 1, 1890, balance unexpended	$1,873.55
Amount appropriated by act approved September 19, 1890	10,000.00
	11,873.55
June 30, 1891, amount expended during fiscal year	2,617.34
July 1, 1891, balance unexpended	9,256.21
July 1, 1891, outstanding liabilities	49.34
July 1, 1891, balance available	9,206.89

Amount (estimated) required for completion of existing project	$14,200.00	
Amount (estimated) required for completion of new project	45,000.00	
		59,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. R. RANSOM, SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Pamlico and Tar rivers during the present fiscal year.

This stream owns for its improvement only one hoister, owned in part by the Contentnia Creek, and this machine has been in use upon the Contentnia up to date since it was repaired early in the spring, and no operations have been attempted the present year.

By authority from you dated November 15, 1890, $8,000 was allotted to be expended upon this river.

Amounts expended during the past year are as follows:

Repairs to hoister	$103.57
Purchase of property	216.78
Gauge observations	30.00
Superintendence	439.79
Labor and supplies	67.85
Total	857.99

So soon as the machinery necessary for the prosecution of the work shall be free for use, and the state of water shall be favorable for its execution, operations will be actively started and continued until the appropriation shall be exhausted.

The increase in export tonnage over that for the preceding year is estimated, from the best reports which could be obtained, at nearly or quite 50 per cent. This is owing to the very poor crops of the preceding year, the excellent one of 1890, and the great increase in the lumber trade. No increase of imports is reported.

When the river shall have been improved up as far as it is deemed advisable, as shown by your reports, we have every reason to expect continued material benefits to follow, not less marked than that shown by past results.

Very respectfully, your obedient servant,

R. Ransom,
Superintendent.

Capt. W. H. Bixby,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1876, the river was irregularly navigated by 3-foot draft steamers up to Tarboro. The commerce is estimated to have then been about $500,000 of goods transported per year. The present commerce is about $6,700,000 of goods transported per year.

Seventeen steamers now ascend the river regularly 37 miles to Washington, and four others make regular trips to Greenville, 23 miles farther, during the whole year, and 26 miles farther to Tarboro during the flush-water season. One of the steamers that usually runs from Baltimore to Washington, N. C., has made a trip to Tarboro and return without hinderance, drawing 6¼ feet of water.

Three-masted schooners with cargoes of ice from the North have also been towed to Greenville to deliver cargoes without breaking bulk.

The present rates of freight are estimated to be from 12 to 50 per cent. less than in 1876.

The river marine insurance is now about one-tenth of 1 per cent.

The commerce is rapidly increasing. Each dollar so far spent on this improvement has been accompanied by the development of about $92 of annual commerce. Washington, N. C., has developed rapidly, and since 1882 the value of its taxable property has increased more than 25 per cent. Greenville had increased from 912 inhabitants and $266,000 real estate in 1880, up to 2,500 inhabitants and $600,000 real estate in 1886, and is still growing rapidly. The development of these towns is almost entirely due to the Government improvement of the river since 1876. This improvement is beneficial not only in this neighborhood, but to the country at large, since the lumber and cotton brought down the river are sent all over the United States, and even to many foreign countries, whence by exchange they return in the form of ice, dry goods, meat, flour, farming tools, etc., an exchange almost entirely due to the lessened freight charges resulting from the recent improvement of the water transportation of this particular stream. It is estimated that the continuation of the present improvement will be followed by a continuation of this rapid development of commerce.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$1,220,500	....	$1,220,500	6,900
Rice	100,600	....	100,600	2,050
Vegetables and truck	100,000	....	100,000	4,500
Live stock and products	51,375	....	51,875	625
Fish, oysters, etc	250,000	....	250,000	14,000
Naval stores	20,000	....	20,000	2,400
Lumber and products	1,800,000	....	1,800,000	225,000
General merchandise	200,000	$3,000,000	8,200,000	22,3[illegible]
Total	3,742,475	3,000,000	6,742,475	277,8[illegible]

Gain over last year, $2,071,665; tons, 99,112.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Superintendent R. Ransom, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present as above shown is	$6,742,475	277,832
The commerce before the improvement began was	500,000	*21,000
The development of commerce since beginning of the improvement is	6,242,475	256,832
Expended on improvement up to 31st December, 1890	67,984	
The development of annual commerce for every dollar spent on the improvement is	92	

* Estimated.

L 8.

IMPROVEMENT OF CONTENTNIA CREEK, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of river, see pages 1010–1012, Annual Report for 1881; for special history of past work, see page 975, Annual Report for 1886; for map of river, see page 1118, Annual Report for 1890.

(2) *Original condition.*—Contentnia Creek, a tributary of the Neuse River, has a total length of about 144 miles, and a drainage area of 1,184 square miles.

When placed under governmental improvement in 1881, this stream had a depth of about 3 feet during 9 months of the year, from its mouth in the Neuse upward about 63 miles to Stantonsburg, its practical limit of navigation; but its channel was completely blocked at all stages of water by sunken logs and stumps and by floating obstructions. Its steamboat commerce was then nothing.

(3) *Plan of improvement.*—The original project of 1881, as continued to date, proposed to secure a safe and unobstructed 3-foot navigation over this entire distance during the high-water season of about 9 months. A personal examination of the river over its entire length in 1884–'85 revealed the agricultural richness of the river basin, its urgent need for better transportation facilities, and the worthiness of the improvement.

The total final cost of this work was estimated in 1888 to be $77,500.

The aggregate amount appropriated for this project up to June 30, 1891, is $52,000.

The funds now on hand will be used up before new appropriations can become available.

(4) *Results.*—Up to 30th June, 1890, a total of $43,928.52, including outstanding liabilities, had been spent in all upon this improvement in securing a moderately well cleared 3-foot navigation over the 31 miles from its mouth up to Snow Hill, and a very roughly cleared 3-foot navigation over the remaining 32 miles to Stantonsburg during the high-water season.

In consequence of this, two steamboats had made trips twice a week a short distance up the river, and two more up to Snow Hill during nearly 9 months each year, the river above Snow Hill was fairly navigable for steamers of 3-foot draft for 8 or 9 months of the year, and flats also plied between Snow Hill and Stantonsburg, to the great benefit of the neighboring country, otherwise without transportation facilities for its products. The work above Snow Hill, though of very recent date, had already produced good results. The commerce (including rafted goods) was rapidly increasing, and was then above $1,200,000 of goods transported per year, showing that each dollar once spent on the improvement has been accompanied by the development of about $28 in annual commerce.

The navigation of this river was not obstructed by bridges without draws, except where under repair.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $4,772.98; value of United States plant, $3,600.

During low water of July, 1890, some work was advantageously done at Spring Slough, near the mouth of the river, and from February to June, 1891, inclusive, the snagging plant did continuous work over 21 miles of river above Snow Hill (from 52 to 31 miles above the river mouth) and occasional work below, removing from the banks 728 trees cut and pulled back, 245 cords brush, 407 logs rolled back, and 82 stumps removed; and from the channel, 454 logs, 102 stumps, 519 large snags, 29 small snags, 120 trees, 132 cubic yards mud, and 34 trees trimmed. All work of snagging and bank trimming was much interfered with by continued high water.

Mile posts were established over the entire length of river to serve as points of reference in reporting obstructions and laying out work.

A small reserve has been retained for special snagging and emergencies.

Water gauges have been kept a three places during the year.

Inspection of property and work has been made during the year.

This improvement has been under the immediate supervision of Superintendent R. Ransom, whose report is herewith appended.

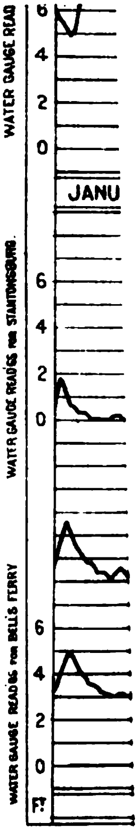
The steamboat navigation is still much obstructed by snags and sunken logs. The commerce has steadily increased, and it is believed that there will be a still larger increase when the river is thoroughly cleared. Otherwise, the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $1,342,100 per year, about 125,225 tons.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the present proposed and approved project, so as to secure a thoroughly cleared 3-foot navigation over the entire river from its mouth upward to Stantonsburg during the nine commercial busy months of the year, at a total expense of $25,500 in addition to the funds available June 30, 1891, this amount to be appropriated in a single sum. Smaller appropriations may increase the cost by from $1,000 to $4,000 per appropriation. Further improvement, so as to extend this navigation above Stantonsburg, or so as to make any part of the river navigable during the low-water season, is not recommended at present.

After the improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

This river is in the second collection district of North Carolina.


WATER GAUGE READ
WATER GAUGE READINGS FOR STANTONSBURG.
WATER GAUGE READINGS FOR BELL'S FERRY
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Money statement.

July 1, 1890, balance unexpended	$1,124.98
Amount appropriated by act approved September 19, 1890	7,000.00
	8,124.98
June 30, 1891, amount expended during fiscal year	4,536.08
July 1, 1891, balance unexpended	3,588.90
July 1, 1891, outstanding liabilities	290.40
July 1, 1891, balance available	3,298.50
Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. R. RANSOM, SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for improving Contentnia Creek, North Carolina, for the present fiscal year.

In July of 1890 a small amount of very useful work was done upon Spring Slough, near the mouth of the stream, thereby improving this channel which has been in constant use since then. One hundred and forty-four stumps were blasted and 11 logs, 17 stumps, 19 cords of small snags, and 132 cubic yards of mud were removed from the slough.

Nothing further was done on account of stage of water and condition of funds till November, when repairs and construction of plant began. This work was completed by the middle of February, 1891, when a plant of two hoisters, two quarter boats, a storehouse, and three flats with small boats was towed by United States steamer *H. G. Wright* to Snow Hill. Work was begun at Snow Hill and proceeded upstream for about 2 miles, when operations were suspended on 6th of March by high water until April, when a third hoister was added to the plant and the whole towed to Spreight's Bridge by hired service. Operations of clearing channel and banks then proceeded downstream to Mile Post 19.

Four hundred and 43 logs, 85 stumps, 519 large snags, 10 cords small snags, and 120 trees were taken from the channel; 727 trees cut and pulled back, 34 trees trimmed, 245 cords of brush cut, 407 logs rolled back, and 82 stumps removed from banks.

The plant returned to the mouth of the stream on the 10th June.

About $1,000 will be needed for special work upon Spring Slough.

Five thousand five hundred dollars was allotted to be expended by me upon this stream from the last appropriation.

The amounts expended during the year are as follows:

Construction and repair of plant	$519.92
Purchase of rope, tools, etc	223.13
Water-gauge observation	32.25
Superintendence	944.88
Labor and supplies	2,632.15
Total	4,352.33

The increase in tonnage for the past year is about 20 to 25 per cent. over the preceding year.

I respectfully and urgently recommend an appropriation in one sum to complete the project adopted. The propriety and utility of this work has been clearly demonstrated.

When the project is completed an annual appropriation of $2,000 to $3,000 should be made to keep the channel clear.

None of the work of the past year is complete, and even where we have gone over it, owing to high water, needful haste and insufficient funds, the character of the work in some places is not as I would like for it to be.

The last property return shows the condition and estimated value of the property. The annual list of floating property will give the location, original cost, and present worth of that property.

Very respectfully, your obedient servant,

R. RANSOM,
Superintendent.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1881 the steamboat commerce was nothing, its rafting commerce was insignificant, and the products of the neighborhood had to be hauled overland long distances to market.

At present five steamboats (with an aggregate tonnage of 250 tons and carrying capacity of 700 bales of cotton) enter this river; of these boats three stop near the mouth and two run 31 miles up the river to Snow Hill during nearly 9 months of the year, carrying over $1,342,000 of goods per year.

The present rates of transportation are estimated to be nearly 50 per cent. less than those of 1881.

The river marine insurance is now only one-tenth of 1 per cent., in contrast to one-eighth of 1 per cent. in 1886, and no fixed rate prior to that time.

The commerce is rapidly increasing. Each dollar so far spent on this improvement has been accompanied by the development of $30 of annual commerce. Bells Ferry, 4 miles from the river mouth, which in 1880 possessed only 1 store, a few houses, and 37 inhabitants, had increased in 1886 up to 37 stores and houses, several churches, mills, and school-houses, with about 200 inhabitants, and a commerce of about $200,000. Snow Hill, 31 miles from the river mouth, had in the same interval increased from 332 inhabitants up to 500 inhabitants. In both towns property had increased in like proportion. It is estimated that the increase for the last year has been at fully as great a ratio, and that this development will continue with the improvement of the river. The benefit of the improvement above Snow Hill is already markedly perceptible. There is in this river basin an exceptionally heavy growth of heavy and valuable timber (pine trees of 6 and 7 feet diameter, oak and gum, yielding sticks 2 feet square and 60 feet long, ash, cypress, maple, and walnut of useful size), which now has a market open to it, which has heretofore been unsalable for lack of transportation. In 1888, 41,000,000 feet of lumber was taken out above Snow Hill as against nothing the preceding year, although the river was not open for even rafting until late in the year.

This improvement is beneficial not only to this neighborhood but to the whole country, since the cotton, timber, and other products are sent to the North and West of the United States, whence by exchange they return in the form of dry goods, hardware, flour, meats, etc., an exchange due almost entirely to the lessened freights resulting from the recent improvement of the water transportation of this particular stream. For example, in 1887, for the first time, the farmers were able to get ice by water from Maine; hay and flour in large quantities by water from the Western States via New York; furniture and fertilizers from South Carolina.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$341,000	....	$341,000	2,225
Rice	2,000	....	2,000	45
Grains and forage	900	....	900	40
Vegetables and truck	28,900	....	28,900	650
Live stock and products	9,050	....	9,050	40
Naval stores	3,000	....	3,000	225
Lumber and products	251,000	....	251,000	115,000
General merchandise	56,250	$650,000	706,250	7,000
Total	692,100	650,000	1,342,100	125,225

Gain over last year, $122,750; tons, 61,975.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Superintendent R. Ransom, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present, as above shown, is	$1,342,100	125,225
The development of commerce since beginning of the improvement is	1,342,100	125,225
Expended on improvement up to December 31, 1890	45,433	....
The development of annual commerce for every dollar spent on the improvement is	30	....

L 9.

IMPROVEMENT OF TRENT RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of river, see pages 713, 714, Annual Report for 1879, and pages 1140–2 for 1889; and for river above Trenton, see pages 1140–2 of Annual Report for 1889; for special history of past work, see page 978, Annual Report of 1886. For maps of river, see page 1054, Report of Chief of Engineers for 1889.

(2) *Original condition.*—Trent River, a tributary of the Neuse River, has a total length of about 73 miles and a drainage area of 657 square miles.

When placed under Governmental improvement in 1879 this stream possessed a 6-foot to 8-foot roughly-cleared navigation from its mouth at New Berne up, 18 miles, to Pollocksville, and a lighter draft navigation 7 miles farther to Quaker Bridge. Above Pollocksville the bars, snags, and trees prevented all navigation, except occasionally by small flatboats during high freshets. Its commerce is now estimated to have then been about $400,000 of goods per year.

(3) *Plan of improvement.*—The original projects of 1879 to 1889, as continued to date, assumed that 6 to 8 feet of water could be carried at all stages 18 miles to Pollocksville, and proposed to secure a thoroughly cleared 3-foot navigation, with at least 50 feet channel width, at all stages of water from Pollocksville, 20 miles up, to Trenton, and at least 30 feet channel width and over 3 feet depth during winter stages of water from Trenton, 30 miles up, to the Narrows above Free Bridge, and a good channel for pole boats 13 miles farther, to Upper Quaker Bridge. A personal examination of the river over its entire length in 1884, 1885, and 1889 revealed the agricultural richness of the river basin, its need of better transportation facilities, and the worthiness of the improvement.

The total final cost of this work was estimated in 1889 to be $72,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $55,500.

The funds now on hand will be exhausted before new appropriations can become available.

(4) *Results.*—Up to June 30, 1890, a total of $50,379.41, including outstanding liabilities, had been spent in all upon this improvement in securing a well-cleared channel 10 to 12 feet deep at all stages (12 to 14 feet deep at ordinary stages) from New Berne up to Pollocksville, thence a channel 6 to 8 feet deep at all stages (8 to 9 feet deep at ordinary stages) 7 miles farther to Quaker Bridge, thence a well-cleared channel 50 feet wide and 3 feet deep at all stages to Trenton, and a good turning basin at Trenton.

In consequence of this improvement steamboat navigation has been established over the entire river to Trenton, making trips weekly in summer and three times a week in the busy winter season. An inspection of this turning basin showed considerable shoaling, due to the town allowing the surface drainage to run into the basin and permitting private individuals to roll logs down the side revetments of the basin.

The commerce was steadily increasing, and was then about $900,000 worth of goods transported per year, showing that every dollar once spent on this improvement has been accompanied by the development of about $10 of annual commerce.

The navigation of the river was not obstructed by bridges without draws.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $3,517.66; value of United States plant, $300.

From January to March 1891, the snagging plant (3 hoisters and necessary boats, went over the river from its mouth to Trenton, removing the worst new obstructions, and then made a first tolerably fair clearing of 7 miles of river just above Trenton, removing from the banks 796 trees cut and pulled back, 187 cords of brush cut, 64 logs and 67 stumps; and from the channel 679 large snags, 453 logs, 141 stumps.

Water gauges were kept at three places on the river.

Inspections of work and property were made during the year.

The improvement has been under the immediate supervision of Superintendent R. Ransom, whose report is herewith appended.

A small reserve has been kept for use in emergencies and for a little special work at specially low water.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended showing a commerce of $1,352,925 per year, about 89,985 tons.

(6) *Recommendations for future work.*—It is recommended that the present approved and adopted project be completed by thoroughly clearing the river up to the Upper Quaker Bridge by removing overhanging trees from the banks and the snags and like obstructions from the channel, at a total final cost of $16,500 in addition to the funds available June 30, 1891.

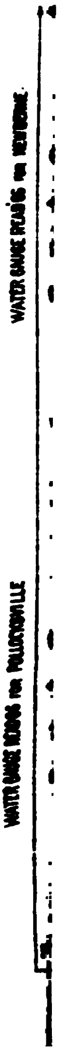
This amount should be appropriated in sums of about $10,000 per year. Smaller appropriations may increase the cost by about $2,000 per appropriation.

After the improvement is finished the proper maintenance of the improved channel may cost from $1,000 to $2,000 per year.

This river is in the collection district of Pamlico, N. C.

Money statement.

July 1, 1890, balance unexpended	$175.12
Amount appropriated by act approved September 19, 1890	5,000.00
	5,175.12
June 30, 1891, amount expended during fiscal year	3,534.56
July 1, 1891, balance unexpended	1,640.56
July 1, 1891, outstanding liabilities	37.63
July 1, 1891, balance available	1,602.93
Amount (estimated) required for completion of existing project	16,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	


WATER GAUGE READINGS FOR NEWBERNE
WATER GAUGE READINGS FOR POLLOCKSVILLE

REPORT OF MR. R. RANSOM, SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Trent River, North Carolina, for the fiscal year ending June 30, 1891.

Authority from you, dated November 15, 1890, placed $3,000 at my disposal for this purpose. As you know, Trent River is without special plant of its own, and that from neighboring streams had to be used for this work. Before operations could begin this plant had to be repaired, and not until late in January, 1891, could work be commenced.

On the 24th of that month the plant was towed to just above Pollocksville, and at the 19-mile post the work began, going over the stream and reclearing from there to Trenton. By the middle of February the river was entirely free from logs, snags, and stumps up to that point, and the plant passed the bridge there and work started upon a part of the river upon which nothing had previously been done. By the 27th of March about 10 miles above Trenton was well cleared of snags and overhanging growth, when operation ceased because of state of funds, and the plant was brought to New Berne on the 31st of March.

During this season's operations 453 logs, 679 snags, and 141 stumps were removed from the channel, and 64 logs cut and rolled back, 796 trees cut and pulled back, 67 stumps removed, and 187 cords of brush cut from the banks.

The plant used consisted of three steam hoisters, two quarter boats, a storehouse, and three flats and small boats.

The steamer *Wright*, belonging to the Government and temporarily in these waters was by your authority used to tow the plant from here to the point of beginning work and subsequently to move the plant up stream until just before reaching Trenton. The hoisters, quarter-boats, etc., belong to the *Neuse* and *Contentnia* works.

The Trent appropriation paid its proper proportion of the expense of repairing the plant.

The amounts expended during the past year have been as follows:

Repair and construction of plant	$207.89
Purchase of property (rope, tools, etc.)	73.35
Water-gauge observation	30.00
Superintendence	528.85
Labor and supplies	2,185.19
Total	3,025.28

There has been an increased tonnage of exports of about 20 per cent. while the imports for the past 12 months have been about the same as for the year previous.

My repeated recommendation of the past must be again urged for the completion of the work projected upon this river. Every best interest will be promoted by an appropriation sufficient to complete the improvement in one season.

The work above Trenton opens a new region untapped by rail or water communication and gives an outlet to timber especially, which daily increases in demand and appreciates in value.

The immediate execution of this season's work has been under Overseer Eugene J. Bell, who has been a subordinate employé for many years and has well earned his promotion. His work merits commendation.

Very respectfully, your obedient servant,

R. RANSOM, *Superintendent.*

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1879 steamers could not go more than 18 miles up to Pollocksville. The river commerce is estimated to have then been about $400,000 of goods per year.

At present steamers make regular trips twice a week in summer and three times a week or daily in the busy season of winter, going 38 miles up the river to Trenton, carrying over $1,350,000 worth of goods per year.

The rates of transportation are estimated at from 25 to 75 per cent. less than those of 1879, and river insurance is regarded as unnecessary, except against fire. Each dollar so far spent upon the improvement has been accompanied by the development of about $19 in annual commerce.

During the past year there has been a considerable increase in the total commerce, due to a large increase in the lumber trade and to the fact that crops throughout this region were unusually good.

It is believed that the future benefit will be in proportion to the past. Half of this river basin is without railroad facilities and must depend upon the river for transportation.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$200,300	....	$200,300	1,6[illegible]
Rice	1,960	....	1,960	[illegible]
Vegetables and truck	15,665	....	15,665	[illegible]
Live stock and products	20,000	....	20,000	[illegible]
Fish, oysters, etc	10,000	....	10,000	[illegible]
Naval stores	5,000	....	5,000	[illegible]
Lumber and products	500,000	....	500,000	[illegible]
General merchandise	....	$600,000	600,000	[illegible]
Total	752,925	600,000	1,352,925	[illegible]

Gain over last year, $394,075.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Superintendent R. Ransom, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
Commerce at present as above shown	$1,352,925	[illegible]
Commerce before the improvement began	400,000	[illegible]
Development of commerce since beginning of the improvement	952,925	67,[illegible]
Expended on improvement up to December 31, 1890	50,687	....
Development of annual commerce for every dollar spent on the improvement	19	....

* Estimated.

L 10.

IMPROVEMENT OF NEUSE RIVER, UP TO SMITHFIELD, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of river, see pages 735–741, Annual Report for 1872; for special history of past work, see page 982, Annual Report for 1886; for map of river, see page 10[illegible], Report of Chief of Engineers for 1889; for map of location of jetties below Kinston, see page 1126 of Annual Report for 1890.

(2) *Original condition.*—The Neuse River, entering into the Pamlico Sound, has a total length of about 360 miles and a drainage area of 5,781 square miles (2,506 of which are situated above the mouth of its upper main tributary, the Contentnia).

When placed under governmental improvement in 1878 this stream possessed during nine months of the year a 9-foot depth of channel from its mouth 40 miles up to New Berne, thence a 4-foot depth 50 miles farther to Kinston, thence a 3-foot depth 45 miles farther to Goldsboro, and thence a 2-foot depth 55 miles farther to Smithfield, this channel depth being reduced during the low-water season to 8 feet at New Berne, 2 feet at Kinston, and 1 foot at Smithfield. Over the whole 190 miles the river was so blocked by war and other obstructions that navigation was impracticable. Its steamboat navigation is now estimated to have then been only about $80,000.

(3) *Plan of improvement.*—The original projects of 1871 for below Goldsboro, and of 1879 above Goldsboro, contemplated the removal of the war blockades and natural obstructions and the excavation of a few cut-offs so as to get 4½ feet at low water all the year to Goldsboro and 3 feet during 9 months to Smithfield. The projects of 1878, 1880, and 1883, as continued to date, proposed to remove all sunken logs, snags, floating and other obstructions, and to contract the channel way by jetties so as to assure during the entire year an unobstructed 8-foot navigation 40 miles up to New Berne, and a similar 4-foot navigation 50 miles farther to Kinston, and during 9 months of the year a 3-foot navigation 100 miles farther to Smithfield. A personal examination of the river in 1884 revealed the agricultural richness of the river basin, its need of free transportation facilities, and the worthiness of the improvement.

The total final cost of this improvement was in 1888 estimated at $374,000.

The aggregate amount appropriated for these projects up to June 30, 1891, is $267,500.

The funds now on hand will be used up before new appropriations can become available.

(4) *Results.*—Up to June 30, 1890, a total of $245,498.43, including outstanding liabilities, had been spent in all upon this improvement, giving a moderately well-cleared channel over the entire length of the river, allowing an 8-foot navigation to New Berne and a 3-foot navigation to Kinston all the year; also a fair 3-foot navigation to Goldsboro during 9 months per year, and thence 55 miles farther to Smithfield, occasionally.

In consequence of this 6 steamboat lines had been permanently established between New Berne and Kinston and running occasionally 24 miles above Kinston; and the river commerce had increased from almost nothing up to over $6,000,000 of goods transported per year, showing that each dollar once spent on this improvement has been accompanied by the development of about $18 of annual commerce.

The navigation of this river was obstructed at points as follows:

Near Kinston this river was crossed by the Atlantic and North Carolina Railroad on a drawbridge, whose draw span is placed upon the shallow side of the river instead of over the main channel-way. The present improvement will probably be so far finished in a few years as to permit of a deeper navigation above this bridge at Kinston than will then be able to pass through this draw opening. All the steamer captains so far heard from state that they have not as yet been delayed from want of water at this draw opening, and there appears no special reason for a change in the position of the draw for a few years. It is recommended that this draw be permitted to remain in its present position for the present, but that it be moved to the channel side of the river as soon as it becomes the chief serious obstruction to a permanently increased depth of navigation between New Berne and Kinston.

Near Goldsboro this river was crossed by the Wilmington and Weldon Railroad on a single-span bridge without a draw. The bottom of the bridge was about 17 feet above low water. The channel was said to be partially obstructed by a pier of the former bridge. Very few steamers had so far reached this bridge, although the river was navigable for several miles above Goldsboro. It is recommended that this bridge be permitted for the present to remain in its present condition, the owners in due time to clear away the obstructing portion to the old pier beneath, and to furnish a suitable hinge-joint to the smoke-stacks of all steamers using regularly this portion of the river.

Above Goldsboro and below Smithfield there were six county bridges without draws, but there had as yet been no navigation demanding draws. When needed the draws will undoubtedly be put in by the county authorities. It is recommended that these bridges be permitted for the present to remain in their present condition, their owners to insert draws therein whenever needed by the steamers.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $8,578.33; value of United States plant, $5,160.

During the working season four steam hoisters and other plant were in use on the river.

Owing to its variable features and the difficulty of properly specifying it beforehand and measuring it afterwards, all work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

From 1st to 20th July, 1890, work of jettying was pushed as rapidly as possible. From 29 to 27 miles above New Berne, 14 sheet-pile jetties (1,361 linear feet) were built in place, 325 linear feet of old jetties were removed, 5 guide piles were driven, 16 mats made and sunk, and 33 logs, 1 stump, 2 trees were removed from the channel, leaving a passage of 125 feet clear width, and from 3 to 4 feet depth at low water. Further work was stopped by high water.

In April, 1891, a snagging plant (2 hoisters and necessary flats) was towed to the Wilmington and Weldon Railroad Bridge at Goldsboro (about 95 miles above New Berne), reaching the Bridge on the 24th; and in June, 1891, another plant (3 hoisters and necessary flats) was towed to Kinston; both plants working downstream from these points.

Between 24th April and 30th June, 1891, from 23 miles of the river between New Berne and Goldsboro Railroad Bridge (from 95 to 75 miles, and from 50 to 47 miles above New Berne) there were removed as follows: From the channel, 487 logs, 598 stumps, 234 trees, 944 large snags, 27 cords small snags, 325 linear feet of old jetty, and 68 old piles; from the banks, 506 trees cut and pulled back, 9 trees trimmed, 107½ cords brush cut, 928 logs rolled back, and 39 large stumps hoisted and blasted.

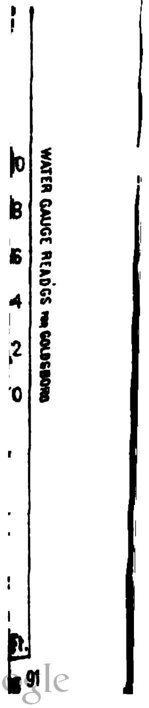
Minor surveys were made near Quaker Bridge (111 miles above New Berne) with reference to cutting a passage through rocky reefs at this point.

Four water gauges were kept during the year.

Inspections of work and property were made during the year.

The improvement has been well carried on under the immediate supervision of Superintendent R. Ransom, whose report is herewith appended.

The work of the past year has much improved the existing fair navigable condition of the river over the 95 miles between New Berne and the Goldsboro Railroad Bridge. The river is well cleared to its natural widths and depths. The commerce of the river is steadily increasing, otherwise the situation remains about the same as at the beginning of the fiscal year.


WATER GAUGE READGS AT GOLDSBORO
10
8
6
4
2
0
Ft.
91

SHEET 2.

PROGRESS MAP ~~for~~ 1891
NEUSE RIVER, N.C.,

FROM 1. JULY 1890 TO 30. JUNE 1891.

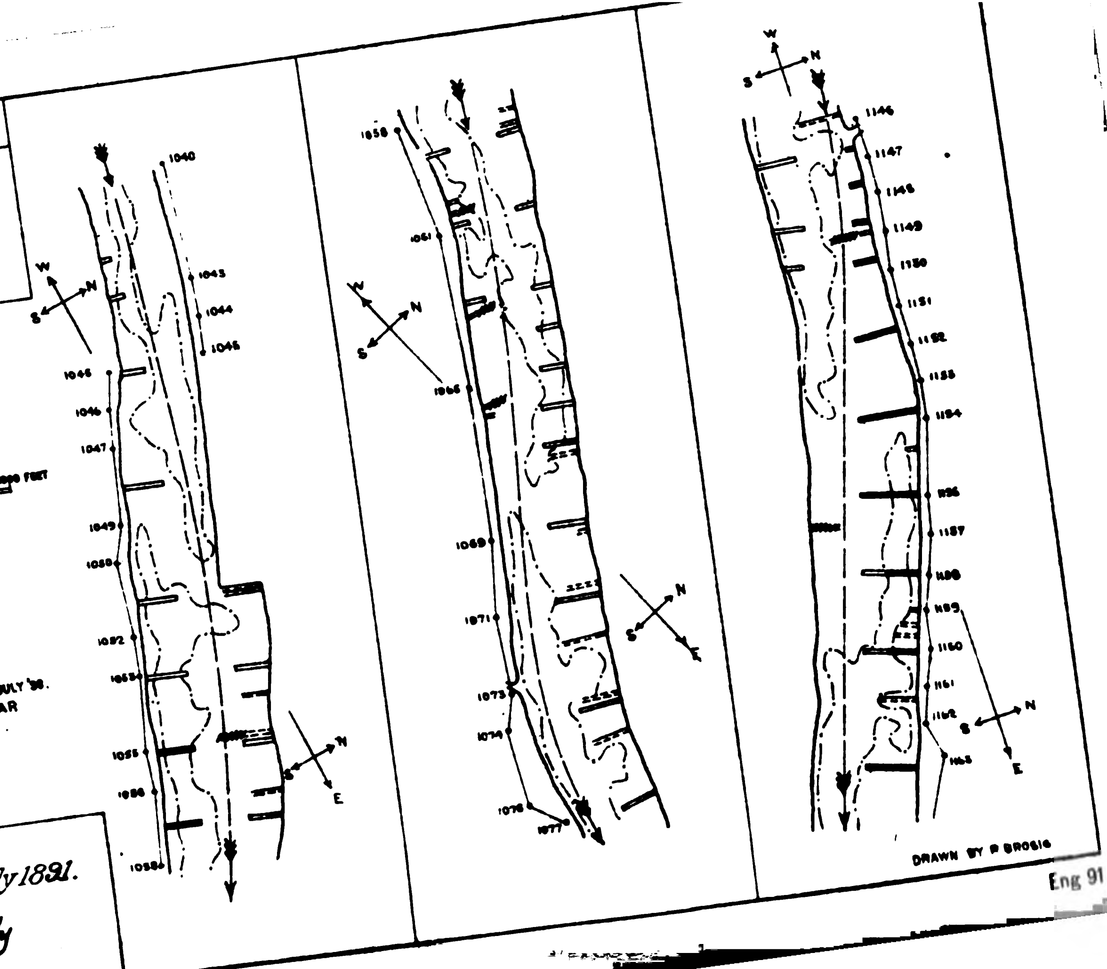
JETTIES

SCALE

100 0 200 400 600 800 1000 FEET

Based on surveys made by R.B. Burks in 1883 under direction of Captain W. H. Bixby, Corps of Engineers, U. S. A.

STAKED LINE OF SURVEY
RIVER BANK AT LOW WATER
3 FT. CURVE " " "
OLD PLANK JETTIES
OLD LOG " OR BUILT PREVIOUS TO JULY '90.
PROPOSED "
JETTIES BUILT DURING } FISCAL YEAR 1890-91.
JETTIES REMOVED "
PROP. MID-THREAD OF CHANNEL



DRAWN BY R BROSIG

Wilmington, N.C. July 1891.

Respectfully submitted
W. H. Bixby
CAPTAIN OF ENGINEERS.

Eng 91

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $8,312,205 per year, about 328,462 tons.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the present approved and adopted projects, so as to secure a thoroughly cleared 9-foot navigation up to New Berne and a similar 4-foot navigation to Kinston during the entire year, and thence a similar 3-foot navigation to Smithfield during 9 months of the year, at a total expense of $106,500 in addition to the funds available June 30, 1891, this amount to be appropriated in yearly installments of as much as $60,000 each. Smaller yearly appropriations, involving the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and the deterioration of plant, may increase the cost of the work by from $2,000 to $6,000 per appropriation. Further improvement, so as to extend the navigation above Smithfield, or so as to increase the depth of water or length of time of such navigation below Smithfield, is not recommended at present.

After the improvement is finished its proper maintenance may cost from $2,000 to $6,000 per year.

This river is in the collection district of Pamlico, N. C.

Money statement.

July 1, 1890, balance unexpended	$4,076.81
Proceeds of sale	175.90
Amount appropriated by act approved September 19, 1890	20,000.00
	24,252.71
June 30, 1891, amount expended during fiscal year	9,378.26
July 1, 1891, balance unexpended	14,874.45
July 1, 1891, outstanding liabilities	1,275.31
July 1, 1891, balance available	13,599.14
Amount (estimated) required for completion of existing project	106,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. R. RANSOM, SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for improving Neuse River, North Carolina, during the fiscal year ending June 30, 1891:

During July last jettying was in progress near Biddle's Landing, and 1,361 linear feet were built that month. Thirty-three logs, 1 stump, 2 trees, 16 large snags, 6 cords of small snags, and 68 old piles were removed in order to put in jetties. The progress map for that month indicates the location of the jetties.

Less than $300 remained available at the end of the month and operations were suspended, and the plant was laid up until November, when the new appropriation became available. All our plant greatly needed repairs, and as soon as possible work was begun upon it to put it in serviceable condition.

In April 2 hoisters, 2 quarter boats, 2 storehouses, and 3 flats, with row boats, in charge of Overseer E. J. Bell, were towed by United States steamer *H. G. Wright*, from New Berne and Biddle's Landing to the Wilmington and Weldon Railroad, 94 miles. About 20 days was consumed in making the transfer.

On April 24 work of clearing channel and bank was begun at Wilmington and Weldon Railroad Bridge, and has progressed downstream to mile post 75, and on June 11, 3 hoisters and necessary quarters and flats, in charge of Overseer Herman Bryan, were towed to Kinston, clearing channel and banks from that point to the forty-seventh mile post.

Over this distance, up to end of June, 454 logs, 928 large snags, 597 stumps, and 232 trees and 21 cords small snags were removed from channel, and 107¼ cords of brush cut, 39 stumps, 506 trees cut and pulled back, 9 trees trimmed and logs cut and rolled back from the banks. The work has been well done and the river is entirely free over this distance from obstructions.

Sixteen thousand dollars was allotted on the 15th November to be expended by me upon this improvement.

The amounts expended during the year are as follows:

Construction and repair of plant	$991.93
Purchase of property (rope, tools, etc.)	445.88
Water-gauge observation	30.00
Superintendence	1,210.95
Labor and supplies	3,830.22
Total	6,508.98

Tide gauges have been kept at Smithfield and other points of work.

It is proposed to continue the work of clearing thoroughly the stream of all obstructions below the Wilmington and Weldon Railroad, and, when the stage of water will permit, to resume jettying below the mouth of Contentnia Creek, and complete the original plan as determined as far down as Anderson's Landing.

After this season, if the stage of water permits fair work, the Neuse River will be in fairly good boating condition from the Wilmington and Weldon Railroad to New Berne, 94 miles, and thence to its mouth. It receives the commerce of the Trent at New Berne, and the Contentnia Creek 30 miles above New Berne, and Swift Creek 8 miles above New Berne.

While it is with great difficulty that we obtain such accurate data as we desire, I am confident that there has been in the past year an increase of tonnage of from 25 to 33 per cent. over the year previous, and from $2,000,000 to $3,000,000 increase in value of its commerce.

When Ocracoke Inlet shall have been improved other work may and probably will be needed in its lower waters to deepen the channel of the Neuse. And attention should be given now to the channels near this place, facilitating the navigation to accommodate the increasing traffic.

I heartily commend an appropriation for the improvement of Swift Creek, a tributary stream leading to the thriving town of Vanceboro and a rich farming country above that place.

The demand for lumber has brought into prominence the value of the timber upon the upper Neuse. Until lately advantage was not attempted to be taken of the improvement made 8 or 10 years ago over this part of the river, *i. e.*, from Goldsboro to Smithfield. Now the inhabitants appreciate its importance, and I can justly commend attention to the wants of the people of this part of the State and recommend an appropriation for the removal of the bad stone shoals near Quaker and Cox bridges, and of those constantly occurring obstructions incident to streams through alluvial regions.

You need no suggestions from me as to the amounts proper for these several objects, but liberality in appropriations, such as will permit the speedy completion of the improvements, would be the wisest and most economical.

Wooden jetties are necessarily perishable and need constant repairs. My last report called attention to the needs in this direction upon this river. Another year without attention to them emphasizes my recommendations, which I here most respectfully but urgently repeat.

Very respectfully, your obedient servant,

R. RANSOM, *Superintendent.*

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1878 all navigation above New Berne was restricted to one small steamer which ran irregularly during the high-water season, carrying about 2,000 bales of cotton per year ($80,000).

At present seven steamers run regularly over parts of the river above New Berne, sometimes as far as to the railroad near Goldsboro (95 miles above New Berne), carrying to New Berne cotton and other products of the country, their return freight being manufactured goods, fertilizers, and articles of general merchandise. Five steamers run regularly over the lower river, going to Elizabeth City, Norfolk, and Baltimore.

The rates of transportation are estimated to be from 25 to 70 per cent. less than in 1878; for example, the freight on cotton is now 75 cents per bale by steamer when formerly it was $2.75 per bale by wagon. Insurance rates have fallen about 30 per cent., and marine insurance is not now considered necessary above New Berne. Each dollar so far spent upon the improvements has been accompanied by the development of about $19 of annual commerce. The effect of the improvements made on the Neuse, Trent, and Contentnia rivers is best shown by the growth of commerce of New Berne, the port of entry for all this traffic.

All this combined commerce passes over the portion of the Neuse below New Berne.

The commerce of New Berne, N. C., for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$1,542,280	....	$1,542,280	9,680
Rice	20,000	....	20,000	445
Vegetables and truck	377,100	....	377,100	16,900
Live stock and products	24,400	....	24,400	130
Fish, oysters, etc	335,200	....	335,200	3,770
Naval stores	83,875	....	83,875	3,200
Lumber and products	1,795,600	....	1,795,600	253,000
General merchandise	383,750	$3,750,000	4,133,750	41,837
Total	4,562,205	3,750,000	8,312,205	328,462

Gain over last year, $1,843,102; tons, 141,824.

Transportation lines established during year: None.

The above statistics are based mainly upon reports of Superintendent R. Ransom, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
Commerce at present, as above shown	$8,312,205	328,462
Commerce before the improvement began	2,000,000	*75,000
Development of commerce since beginning of the improvement	6,312,205	253,462
Expended on improvement of Trent, Neuse, and Contentnia Creek, up to December 31, 1890	344,315	....
Development of annual commerce for every dollar spent on the improvements	19	....

*Estimated.

L II.

IMPROVEMENT OF INLAND WATER-WAY BETWEEN NEW BERNE AND BEAUFORT HARBOR, NORTH CAROLINA, VIA CLUBFOOT, HARLOWE, AND NEWPORT RIVERS.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For original estimates and description, see page 894, Annual Report for 1880; for special history of past work, see page 985, Annual Report for 1886; for map of route, see page 1130, Annual Report of 1890; and for maps of work done, see page 1062 Annual Report of 1889.

(2) *Original condition.*—The inland line of navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, was es-

tablished in about 1826, and was used thereafter by small craft until about 1856, when its locks broke down and the route was abandoned. This line, about 39 miles in total length, extends from New Berne about 21 miles down the Neuse River, 5 miles up Clubfoot River, 3 miles through the Clubfoot and Harlowe Canal, 4 miles down Harlowe River, and 6 miles through Newport River to Beaufort Harbor. About 1880 the line was reopened by the New Berne and Beaufort Canal Company.

When placed under governmental improvement in 1885 this route allowed the passage of small boats of 15 feet width and 3-foot draft; but the commerce was then practically nothing.

(3) *Plan of improvement.*—The original project of 1883 reported this route via Clubfoot, Harlowe, and Newport rivers as worthy of improvement, providing that Congress desired to extend the already existing lines of navigation from the Chesapeake southward, and estimated the cost of a channel 80 feet wide and 9 feet deep at $883,580, increased by the cost of a tide lock and the canal company's franchise. A modified project of 1884 for the expenditure of the funds at that time available as continued to date proprosed to widen and deepen Harlowe Creek so as to secure a through canal of 5-foot depth at mean low water and of 30-foot bottom width from the mouth of Harlowe Creek upward 4 miles to its head, and to use the remaining funds upon similar works on Clubfoot River.

The total final cost of the latter (1884) project (including also the completion of the canal) so as to secure a channel 30 feet wide and 5 feet deep at low water from the Neuse River through to Newport River, adapted to the existing navigation of the Neuse River desiring passage by this route to Beaufort Harbor, was estimated in 1886 to be $92,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $35,000.

(4) *Results.*—Up to June 30, 1890, a total of $26,603.12, including outstanding liabilities, had been expended in all upon this improvement, in necessary surveys, in the removal of the worst logs and stumps in the existing channel, in dredging the creek for a short distance to full dimensions, and in clearing it over its entire length to a width and depth sufficient to allow the passage of small sail boats of as great draft as could pass through the canal.

In consequence of this, several hundred sailboats had passed through the canal, and the commerce of this route had already reached about $200,000 per year, and is rapidly increasing. Rates of transportation between New Berne and Beaufort had dropped about 25 per cent. since the improvements has commenced; and each dollar once spent upon this improvement has been accompanied by the development of more than $7 of annual commerce.

The navigation of this route was not obstructed by bridges without draws.

The funds at present available have been retained to await developments as to the proposed action of the corporation owning the New Berne and Beaufort Canal, connecting Harlowe Creek with Clubfoot Creek. Verbal statements of the former president of this canal company and of the present governor of the State of North Carolina tend to show that the canal company has in the past few years received from the State of North Carolina a present of enough money to put the canal in good navigable condition; but that it was not willing to cede even the canal to the United States, except in return for an additional large sum of money.

A new canal, paralleling the old one, now appears from several points of view to be preferable to the old one, unless the latter is ceded to the United States free of charge.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $476.28; value of United States plant, $420.

Owing to its variable features and to the difficulty of properly specifying it beforehand and measuring it afterwards, all minor work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

The results produced by the sheet-piling built in place in the lower creek have been very satisfactory. Sixty linear feet of new jetty have been built and 3,390 linear feet of these jetties have been riprapped with oyster shells.

In August, 1890, all active operations in the field were suspended, and work has since been confined to office duties and minor work awaiting cession of the canal.

The work of this improvement during the year has been efficiently carried on under the immediate supervision of Assistant Engineer W. H. Chadbourn, jr., whose report is herewith appended.

Inspections of the property and work were made during the year.

The work on Harlowe Creek, formerly the narrowest and most dangerous part of this canal route, has completed an excellent channel for 5-feet-draft boats the entire length of Harlowe Creek, and has made the Government portion (the ends) of this route fully equal to the central portion, now owned by private parties.

Many small schooners now make daily use of this route, and preparations are being made to add steam service. The commerce of the route is rapidly increasing. Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $290,000 per year, about 14,000 tons.

This commerce would have easily reached $300,000 per year had it not been for the insufficient depth of the canal owned by private parties, forcing vessels to use the Core Sound route.

(6) *Recommendations for future work.*—It is recommended that this improvement be extended in general accord with the projects of 1883 and 1884 over the whole distance through the New Berne and Beaufort Canal, as well as through Clubfoot River and Harlowe Creek, so far as to secure a channel of 5 feet depth at mean low water and 30 feet bottom width from the mouth of Harlowe Creek to the mouth of Clubfoot River, thus completing a 5-foot navigation from New Berne to Beaufort, at a total expense of $57,000, in addition to the funds available, June 30, 1891, this amount to be appropriated in one sum; but that *no new funds be made available until this canal shall be ceded to the United States free of charge.*

Smaller yearly appropriations, involving the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence and the deterioration of plant, may increase the cost of the work by from $1,500 to $4,000 per appropriation.

A personal inspection of this route in 1885 revealed the worthiness of this improvement. If well opened this line would be of much value as a connecting link between Pamlico Sound and Beaufort Harbor, and would complete an otherwise already existing inland navigation from the Chesapeake to Beaufort, N. C. The dangers of ocean travel around Cape Hatteras and Cape Lookout are so great that some such 5-foot navigation for small vessels appears necessary between Pamlico Sound and Beaufort Harbor, and no similar navigation can be secured by any other existing route except at greatly increased expense. Further improvement over this route so as to secure a channel of more than 5 feet depth at low water is not recommended for the present.

After this improvement is completed, its proper maintenance may cost from $1,000 to $3,000 per year.

This water-way is in the collection district of Pamlico and Beaufort, N. C.

Money statement.

July 1, 1890, balance unexpended	$8,401.88
June 30, 1891, amount expended during fiscal year	481.28
July 1, 1891, balance unexpended	7,920.60
Amount (estimated) required for completion of existing project	57,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	57,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. W. H. CHADBOURN, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Beaufort, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the water way between New Berne and Beaufort, N. C., during the fiscal year ending June 30, 1891:

This water way has been in my charge since January 23, 1891.

Work has been entirely suspended on this water way, awaiting action on the part of the private company owning the New Berne and Beaufort Canal, forming a part of this water way. At present the approaches to the canal are reported to have a greater depth of water than the shoalest part of the canal itself.

Owing to the small amount of money at my disposal I have made no examination of this water way or inspection of the work done by the United States in previous years.

There has been a decrease in tonnage passing through this water way owing to the canal being obstructed by a dredge operating for the canal owners.

No new lines of transportation have been established during the year.

Very respectfully, your obedient servant,

W. H. CHADBOURN, Jr.,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced on this improvement in 1883 there was no navigation or commerce by this route.

At present vessels drawing 3½ feet make regular trips, except when prevented by slides, caves, and consequent insufficient depth in the New Berne and Beaufort Canal (owned by private parties as above stated).

The improvement, though quite recent and still incomplete, has already brought about a reduction of about 25 per cent. in freight charges between New Berne and Beaufort, and each dollar so far spent upon the improvement has been accompanied by the development of about $11 of annual commerce.

This water way affords a short nearly direct route to all vessels able to use it, from Pamlico Sound, Neuse River, and their tributaries, to Beaufort Harbor, Core and Bogue Sounds, White Oak River, and the ocean. It completes the existing line of inland navigation from Chesapeake Bay to Beaufort Harbor, and its final completion will insure a good 5-foot navigation at low water between these points, avoiding the dangers of Hatteras and Lookout and the shoals of Core Sound.

During the past year traffic by this route was much hindered and interfered with by a dredge in the above-mentioned canal, which prevented the passage of boats for a great portion of the year so that many vessels which would have used this water way were compelled to adopt the longer route through Core Sound. As this Core Sound commerce is mainly a commerce between New Berne and Beaufort, and appears in no other report, it is deemed only fair to include it in the commercial statistics of this water way between New Berne and Beaufort.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$50,000	....	$50,000	815
Tobacco	....	$1,000	1,000	5
Rice	2,000	....	2,000	45
Grains and forage	1,000	4,000	5,000	300
Vegetables and truck	5,000	....	5,000	230
Live stock and products	2,500	5,500	8,000	60
Fish, oysters, etc	16,000	....	16,000	1,750
Naval stores	7,000	....	7,000	275
Lumber and products	5,500	....	5,500	1,900
Fertilizers	3,000	....	3,000	150
Machinery	....	1,500	1,500	100
General merchandise	5,000	31,000	36,000	1,650
Sundries	1,000	....	1,000	200
Actually passing over this water way	98,000	43,000	141,000	6,980
Commerce through Core Sound which would have passed over this water way had canal been open	70,000	79,000	149,000	7,020
Grand total	168,000	122,000	290,000	14,000

Gain over last year, $90,075; tons, 4,848.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer William H. Chadbourn, jr., made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present as above shown is	$290,000	14,000
The commerce before the improvement began was	Nothing.	....
The development of commerce since beginning of the improvement is	290,000	14,000
Expended on improvement up to 31st December, 1890	27,079	....
The development of annual commerce for every dollar spent on the improvement is	11	....

L 12.

IMPROVEMENT OF HARBOR AT BEAUFORT, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of harbor, see pages 1013–1017, Annual Report of 1881; for special history of past work, see page 989, Annual Report of 1886, and for maps of harbor, see page 1076, Annual Report of 1885, and page 1136 of 1890.

(2) *Original condition.*—Beaufort Harbor, at the eastern terminus of the Atlantic and North Carolina Railroad, is the only harbor of any importance between Chesapeake Bay and Wilmington, N. C., a distance of over 300 miles. It is especially valuable as the natural outlet to the inland commerce of northern and middle North Carolina, and as a natural harbor of refuge to vessels overtaken on this most exposed portion of the Atlantic coast. If its channel were marked by range

lights it would be one of the easiest harbors to enter between the Chesapeake and Savannah.

When placed under governmental improvement in 1880, this harbor possessed a bar entrance of 15.3 feet least depth at mean low water, with an average rise and fall of tide of 3 feet. At this time, however, the harbor entrance was rapidly deteriorating, its width, measured from Fort Macon Point to Shackleford Point, having increased 500 feet between the years 1864 and 1880 and 900 feet more between the years 1880 and 1881, and its bar having rapidly and proportionately shoaled. From the bar the harbor possessed a channel of 25 feet depth for 3.7 miles up to the Atlantic and North Carolina Railroad Wharf at Morehead City, and a branch channel of 9 feet depth for 0.6 miles up to Bulkhead Channel, and of 2 feet minimum depth for 0.6 miles further to the wharves of Beaufort City, where coasting vessels had a good wharfage of 7 feet depth and 1,800 feet length. Its commerce is now estimated to have been about $1,000,000.

(3) *Plan of improvement.*—The original project of 1881 proposed to stop the erosion at Shackleford Point by jetties; to extend the 9-foot depth of water from Bulkhead Channel to Beaufort City by a cutting 200 feet wide, and thence to dredge a 6-foot channel 100 feet wide to North River and Core Sound for the accommodation of the small craft of the neighboring sound. The projects of 1881, 1882, and 1884, as continued to date, proposed to secure this harbor by stopping further erosion of the sand banks at Shackleford Point and Fort Macon Point, and thus stopping further deterioration of the bar entrance, and proposed to open a 7-foot channel 100 feet wide to Beaufort City. A personal examination of the locality and work in 1884 revealed the need of such work and its importance. Inadequate yearly appropriations and their consequences (the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and deterioration of plant) have added considerably to the cost of the work.

The total final cost of this work was estimated in 1887 at $163,000.

The aggregate amount appropriated for these projects up to June 30, 1891, is $140,000.

The funds now on hand will all be used up before new appropriations can become available.

(4) *Results.*—Up to June 30, 1890, a total of $122,034.43, including outstanding liabilities, had been spent in all upon this improvement in successfully stopping the erosion of Shackleford Point and Fort Macon Point, in arresting the shoaling upon this bar, and in making a careful survey of the present condition of the harbor entrance preparatory to the definite location of further works.

No special improvement of depth of water was thereby expected or obtained, but the retrograde movement had been in general arrested, the old shore lines had reformed to a considerable extent as desired, and the former good condition of the harbor entrance was being rapidly established. The commerce was then about $2,150,000 of goods exported and imported, showing that every dollar once spent upon this improvement has been accompanied by the development of about $10 of annual commerce.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $1,638.91; value of United States plant, $3,025.

Owing to its variable features and the difficulty of properly specifying it beforehand and measuring it afterwards, all minor work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

Contracts for work under new appropriations with the Alabama Dredging and Jetty Company were approved in January, 1891, work to commence on or before 3d July, 1891, or upon completion of contract work on Bogue Sound.

At Shackleford Point there are now about 8,000 linear feet of moveable catch-sand fencing, and at Fort Macon Point about 4,000 linear feet. These fences were, from time to time, raised a foot or two as sand accumulated about them, this accumulation being found to take place very rapidly and in a highly satisfactory manner.

Two hundred and eighty linear feet of brush and stone revetment were built at Shackleford Point across a small slough.

During the year several minor surveys have been made of past work and of the shore lines at both Shackleford Point and Fort Macon as a check upon the effect of past work, and to obtain data for the proper prosecution, record, and comparison of future work.

Inspections of property and work were made several times during the year. These inspections showed marked successful results at all the jetties, brush and stone revetments, and fences and crib work of past years. The shore line is now rapidly building out towards the ocean at points where it formerly was cutting away the most quickly.

The work of this improvement during the past year has been vigorously and very efficiently carried on under the immediate supervision of Assistant Engineer W. H. Chadbourn, jr.

The work of the past year has much assisted in the preservation of this harbor. The channel cut through Beaufort City Shoal has widened considerably under the influence of the tidal scour, and now affords an easy route from the entrance of the harbor to the city wharves.

Most of the jetties have been raised to about the high-tide line.

The shore revetments have assisted in the preservation of the beach, and the sand fences have been markedly successful in building up the area reclaimed from the ocean.

The Shackleford Channel and the available depth on the bar have both been greatly improved.

Shackleford Point is rapidly moving back to its best condition of nearly 50 years ago. Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $2,324,500 per year (about 46,675 tons).

(6) *Recommendations for future work.*—It is recommended that the present approved projects be completed so far as to thoroughly protect Shackleford and Fort Macon points from further erosion, and to dredge a reduced channel of 100 feet width and 7 feet depth at low water from Bulkhead Channel entirely through to Beaufort City, at a total expense of $23,000, in addition to the funds available on June 30, 1891, this amount to be appropriated in one sum during the next year. Smaller yearly appropriations, involving the alternate disorganization and reorganization of working parties, deterioration of unfinished work, extra superintendence, and detorioration of plant, may increase the cost of the work by from $3,000 to $5,000 per appropriation.

Further improvement in accord with the original project, so as to secure to Beaufort City a channel of over 7 feet depth at low water from Bulkhead Channel, is not recommended at present. This improvement once thoroughly completed should be permanent.

The harbor entrance needs a pair of range lights visible to a distance of 6 miles. It would then be of great value as a harbor of refuge. The least depth of water in this bar could probably be easily increased to 18 feet at low water, as it is said to have been in 1737 and 1830; $500,000 spent in a single jetty on the east side of the entrance would probably cover the entire cost of this increase of depth.

Beaufort is a port of entry.

Money statement.

July 1, 1890, balance unexpended		$3,140.04
Amount appropriated by act approved September 19, 1890		15,000.00
		18,140.04
June 30, 1891, amount expended during fiscal year		1,680.53
July 1, 1891, balance unexpended		16,459.51
July 1, 1891, outstanding liabilities	$132.85	
July 1, 1891, amount covered by uncompleted contracts	12,000.00	
		12,132.85
July 1, 1891, balance available		4,326.66
Amount (estimated) required for completion of existing project		23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		23,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging harbor at Beaufort, N. C., opened at 12 o'clock, m., December 16, 1890, by Capt. W. H. Bixby, Corps of Engineers.

No.	Name and address of bidder.	Price bid.	Remarks.
1	Chester T. Caler, Norfolk, Va	39 cents per cubic yard, in scows	Will commence October 20, 1891; 150 to 2 yards daily.
2	Skinner & Wallace, Wilmington, N. C.	37 cents per cubic yard, in scows	Within 6 months; 1, yards weekly.
3	Alabama Dredging and Jetty Co., Mobile, Ala.	33½ cents per cubic yard, in scows.	Within 5 months; 2 yards weekly.

Amount of dredging bid for, $10,000 to $12,000.

Recommended to be awarded to bidder No. 3, Alabama Dredging and Jetty Company.

There is available for the work of improving harbor at Beaufort, N. C., the sum of $17,000.

REPORT OF MR. W. H. CHADBOURN, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Beaufort, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the improvement of the harbor at Beaufort, N. C., during the fiscal year ending June 30, 1891.

This harbor has been in my charge since January 23, 1891.

No dredging has been done in this harbor during the year, but a contract was made December 24, 1890, with the Alabama Dredging and Jetty Company for from $10,000 to $12,000, work to begin not later than July 1, 1891.

Examinations have been made of the dredging done in former years, and it was found to be in good condition, but slowly scouring on both sides and bottom.

Until May 15, 1891, a regular force of two men were kept busily at work raising the sand fences at both Fort Macon and Shackleford points, and a large amount of sand has been accumulated on what was formerly a low flat beach.

Minor surveys have been made of the low-tide beach line at Shackleford Point and of Shoal L at Beaufort.

The expenditures under my direction have been:

For superintendence and surveys	$162.31
For manual labor	334.03
For purchase and repair of property	40.21
Total	536.55

Very respectfully, your obedient servant,

W. H. CHADBOURN, JR.,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When this improvement was commenced, in 1881, the sand banks which limit the width of the harbor entrance were rapidly wearing away (a sixth of a mile in 1 year), and the harbor entrance bar was rapidly shoaling. The commerce is estimated to have then been about $1,000,000.

No marked improvement was expected or has been obtained in commerce or navigation or in the rates of freight and insurance. The deterioration has been stopped, and the former good condition of the harbor entrance is being reëstablished. The depth of water on the bar is now about 14 feet at low water, and the harbor entrance is constantly improving.

The commerce is now estimated to be about $2,324,500 of goods transported per year.

This harbor, at the eastern terminus of the Atlantic and North Carolina Railroad, is the only harbor of special importance between Chesapeake Bay and Wilmington, N. C., a distance of over 300 miles. It is especially valuable as being the natural outlet of Albemarle and Pamlico sounds, and of the inland commerce of northern and middle North Carolina, and as being also a harbor of refuge for vessels overtaken on the exposed portion of the Atlantic coast embracing Capes Hatteras and Lookout. If its channel were properly marked by range lights it would be one of the safest and easiest harbors to enter between the Chesapeake and Savannah. Large numbers of shallow-draft coasting vessels from the Tar, Pamlico, Trent, Contentnia, and Neuse rivers, and from Albemarle and Pamlico sounds, come by way of the New Berne and Beaufort Canal or Core Sound, and pass through this harbor on their way south to Wilmington, Georgetown, Charleston, and Savannah, this harbor affording them a safe and convenient exit to the ocean, and permitting them to avoid the dangers of ocean navigation outside Hatteras or Lookout. The preservation and development of this harbor is of great importance to the whole State of North Carolina. Its natural advantages are such that, with proper developments, this would become one of the principal harbors of the southern coast.

Its total present commerce is reported as follows;

Movement of vessels.

Description.	No.	Tons.
Sail vessels owned at Beaufort, N. C	138	2,024
Steam vessels owned at Beaufort, N. C	2	121
Sail vessels built at Beaufort, N. C	17	....
Vessels, increase over last year	16	....
Vessels passed through Core Sound, and out of Beaufort Harbor Inlet: Sail vessels, (estimated), yachts, and passenger boats	....	30,000

No records are kept of vessels arriving at or departing from Beaufort, N. C.

The commerce passing through the harbor as given in the above summary is estimated at about 15,000 tons per year—value $1,200,000, consisting of grain, fertilizers, lumber, general merchandise, and sundries.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$76,000	....	$76,000	500
Tobacco	40,000	$50,000	90,000	180
Rice	3,000	1,000	4,000	85
Grains and forage	....	27,000	27,000	930
Vegetables and truck	63,500	....	63,500	1,430
Live stock and products	20,000	55,000	75,000	700
Fish, oysters, etc	230,000	30,000	260,000	14,000
Lumber and products	5,000	....	5,000	875
Coal and minerals	....	23,000	23,000	4,325
Fertilizers	26,000	25,000	51,000	2,550
Machinery	....	27,000	27,000	100
General merchandise	135,000	270,000	405,000	4,000
Sundries	13,000	5,000	18,000	2,000
Total	611,500	513,000	1,124,500	31,675
Passing through the harbor	600,000	600,000	1,200,000	15,000
Grand total	1,211,500	1,113,000	2,324,500	46,675

Gain over last year, $190,500.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer W. H. Chadbourn, jr., made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present, as above shown, is	$2,324,500	46,675
The commerce before the improvement began was	1,000,000	*25,000
The developement of commerce since beginning of the improvement is	1,324,500	21,676
Expended on improvement up to 31st December 1890	123,020	....
The development of annual commerce for every dollar spent on the improvement is	10	....

*Estimated.

L 13.

IMPROVEMENT OF INLAND WATER-WAY BETWEEN BEAUFORT HARBOR AND NEW RIVER, THROUGH BOGUE SOUND, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of this sound, see pages 1135–1139, Annual Report for 1885; and for map of location of channel, see page 1074, Annual Report of 1889.

(2) *Original condition.*—Bogue Sound is an open water way, lying between the mainland and an outer line of sand banks, extending from Beaufort Harbor 24 miles westward to Bogue Inlet and White Oak River, and being prolonged by narrow, crooked, tide-water creeks 17 miles farther through salt-water marshes to New River, North Carolina.

The sound and marsh vary from 1 to 2 miles in width; the channels and creeks from 10 to 400 feet in width and from 6 inches to 8 feet in depth; and the rise of tide from 0 to 5 feet, according to location and prevailing winds. This water-way forms a portion of one of the proposed routes of inland navigation from the Chesapeake to Wilmington, N. C.

When placed under governmental improvement in 1886 this waterway possessed an 18-inch depth of channel at low water from Beaufort to the town of Swansboro, on White Oak River; thence a 3-foot depth at mid-tide 6 miles farther to Bear Inlet and Creek; thence a 6-inch depth at low water 11 miles farther to New River, whence boats of 5 feet draft could proceed 14 miles farther to the town of Jacksonville. (See report on New River, North Carolina.) Its commerce is estimated to have then been about $200,000 per year, carried by sailboats of less than 2 feet draft.

(3) *Plan of improvement.*—The original project of 1885, as continued to date, recommended the establishment of a channel of at least 3 feet depth at low water from Beaufort to Swansboro; White Oak River itself having been in 1889 recommended as worthy of improvement, see pages 1127–1129 of Annual Report for 1889. Personal inspection has shown White Oak River Basin to be agriculturally rich and apparently capable of adding $500,000 annual commerce to Bogue Sound as soon as the latter is open to 3-foot-draft steamers.

The total final cost of this work was estimated in 1887 to be $50,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $30,000.

(4) *Results.*—Up to June 30, 1890, a total of $14,637.89, including outstanding liabilities, has been spent in all upon this improvement in necessary surveys and in dredging so as to secure a channel of at least 40 feet width and 3 feet depth at ordinary high tide over the entire route.

In consequence of this work a small steamer had been built to ply between Beaufort and Swansboro. No special improvement of commerce was to be expected until the work is complete.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $4,866.92; value of United States plant, $200.

Owing to its variable features and to the difficulty of properly specifying it beforehand and measuring it afterwards, all minor work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

Contract for work under new appropriations with the Alabama Dredging and Jetty Company was approved in January, 1891, work to commence by 3d March, 1891, and to be finished by 3d July, 1891.

Under this contract, and between the 1st February and 23d March, 14,773 cubic yards of sand and mud were removed from 3,395 linear feet of cutting, leaving a clear channel of at least 40 feet width and at least 3 feet depth at low water. This work was temporarily suspended in March at the request of the contractor, to await the construction of a special dredge.

Minor surveys have been made during the year, and show that all channels dredged in past years have retained, and in many cases have increased, their originally dredged depths.

Office reports and records have been continued during the year and a small reserve has been kept for use in emergencies.

Government property has been stored and cared for at Beaufort, N. C.

Inspections of the work have been made during the year.

This improvement has been under the immediate and efficient supervision of Assistant Engineer W. H. Chadbourn, jr., whose report is herewith appended.

Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $478,200 per year (about 29,332 tons).

(6) *Recommendations for future work.*—It is recommended that the present approved project be completed, so far as to secure a continuous channel of 100 feet width and at least 3 feet depth at low water from Beaufort Harbor to Swansboro, White Oak River, and Bogue Inlet, at a total expense of $20,000 in addition to the funds available June 30, 1890; this amount to be appropriated in one sum, under the title of Beaufort Harbor to Swansboro, N. C. Smaller yearly appropriations, involving the disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and deterioration of plant, etc., may increase the cost of the work by from $2,000 to $6,000 per appropriation.

Further improvement, so as to secure greater width and depth of channel, is not recommended at present. The improvement, once thoroughly finished, should remain comparatively permanent.

This water-way is in the collection district of Beaufort, N. C.

Money statement.

July 1, 1890, balance unexpended		$362.11
Amount appropriated by act approved September 19, 1890		15,000.00
		15,362.11
June 30, 1891, amount expended during fiscal year		4,394.72
July 1, 1891, balance unexpended		10,967.39
July 1, 1891, outstanding liabilities	$472.20	
July 1, 1891, amount covered by uncompleted contracts	5,306.82	
		5,779.02
July 1, 1891, balance available		5,188.37
Amount (estimated) required for completion of existing project		20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging water-way between Beaufort Harbor and New River, North Carolina, opened at 12 o'clock m., December 16, 1890, by Capt. W. H. Bixby, Corps of Engineers.

Name and address of bidder.	Price bid.	Remarks.
1. Skinner & Wallace, Wilmington, N. C.	29 cents per c. yd. in situ.	Will commence within 60 days, and 800 yards weekly.
2. Alabama Dredging and Jetty Company, Mobile, Ala.	25 cents per c. yd. in situ.	Will commence within 30 days, and 2,000 yards weekly.

Amount of dredging bid for, $7,000 to $9,000.

Recommended to be awarded to bidder No. 2, Alabama Dredging and Jetty Company.

There is available for work of improving water way between Beaufort Harbor and New River, North Carolina, the sum of $15,000.

PROGRESS MAP FOR 1891

BEAUFORT TO NEW RIVER, N.C.

FROM 1. JULY 1890 TO 30. JUNE 1891.

SHEET
Nº2

SALLY BELL'S SHOAL

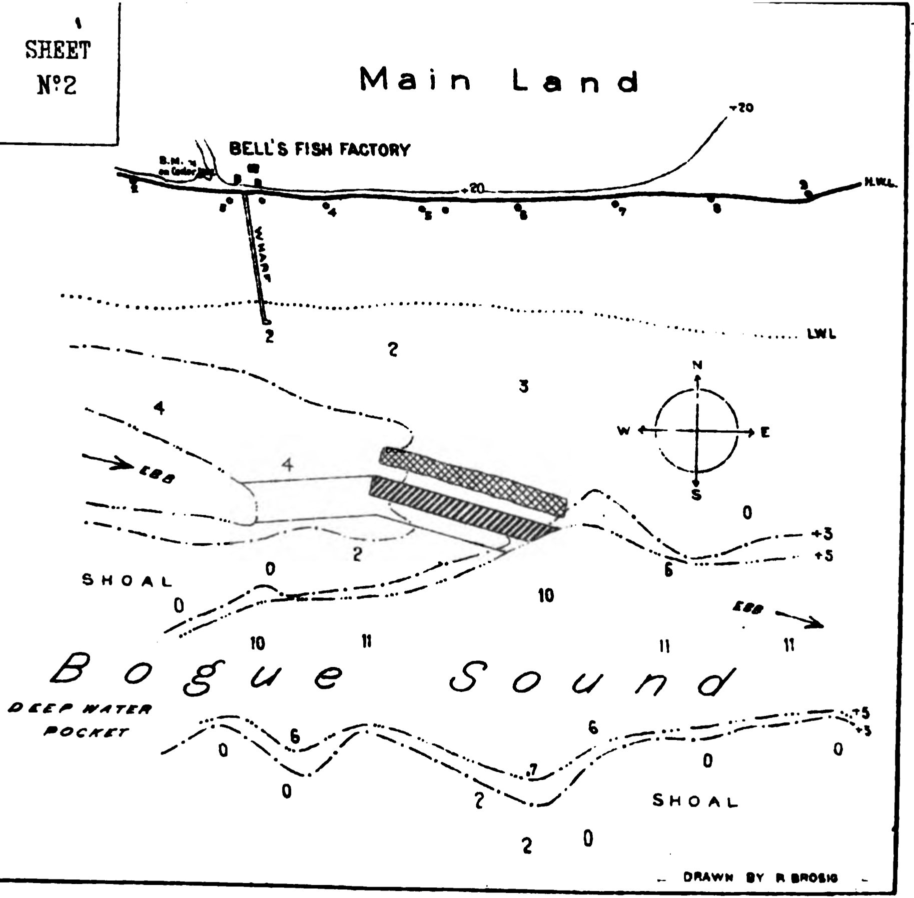
8 MILES FROM BEAUFORT, N.C.

SCALE OF FEET

0 200 400 600 800 1000 FT.

Based on map of E.D. Thompson, 1887.

• • • SURVEY STAKES
—— 20 FT. CONTOUR ABOVE DEAD LOW WATER
▬▬ HIGH WATER SHORE LINE
……… LOW " " "
-·-·- 3 FT. CONTOUR BELOW DEAD LOW WATER
-··- 5 FT. " " " " "
▭ UNCOMPLETED CHANNEL
▨ DREDGING OF FISCAL YEAR 1890-91 TO 5 FT. DEPTH AT D.L.W.
▩ DUMPAGE



Wilmington, N.C. *July 1891.*

Respectfully submitted

Wm H Bixby
CAPTAIN OF ENGINEERS

Eng 91

# PROGRESS MAP FOR 1891
# BEAUFORT TO NEW RIVER, N.C.
FROM 1. JULY 1890 TO 30 JUNE 1891.

SHEET
N°3

SANDER'S CREEK SHOAL

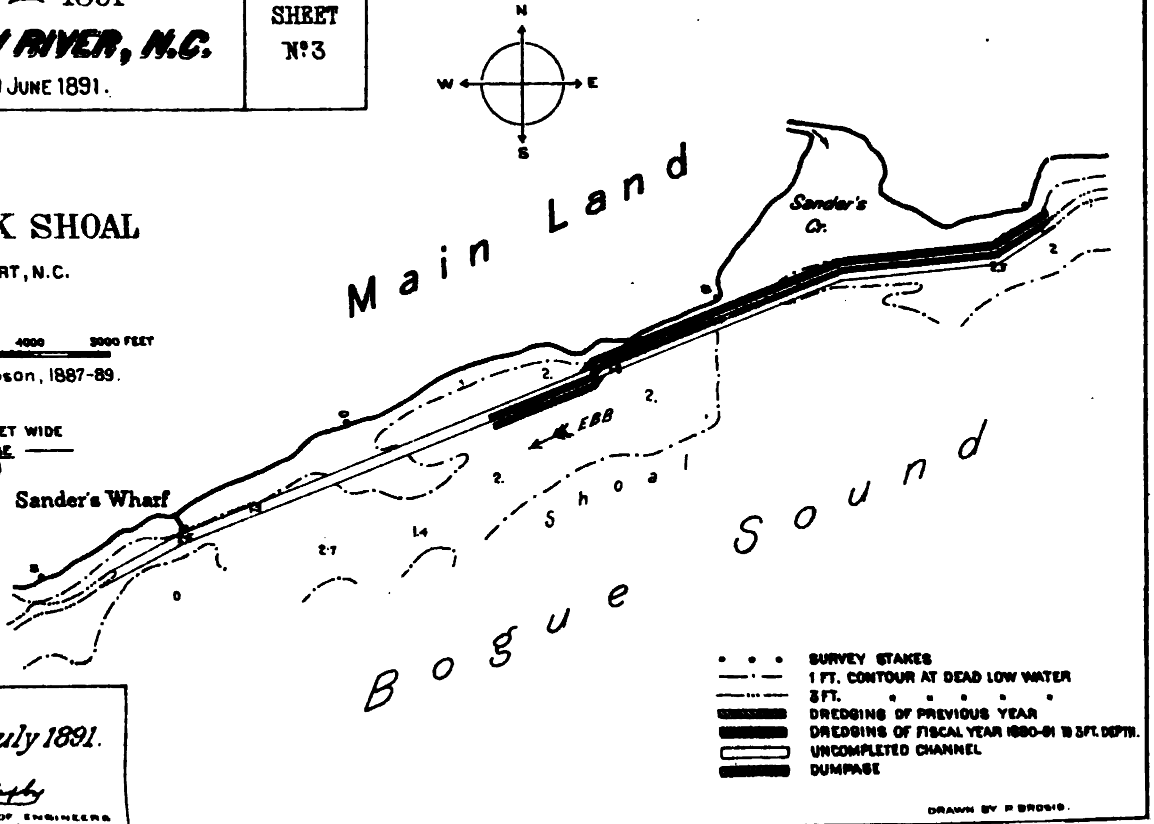
18 MILES FROM BEAUFORT, N.C.

SCALE OF FEET

0 1000 2000 3000 4000 5000 FEET

Based on map of E.D. Thompson, 1887-89.

—— PROPOSED CHANNEL 100 FEET WIDE
SAME SCALE APPLIES TO DUMPAGE ——
(WIDTHS EXAGGERATED 50 PERCENT)



Wilmington, N.C. *July 1891.*

Respectfully submitted W. H. Bixby
CAPTAIN OF ENGINEERS.

Eng 91

REPORT OF MR. W. H. CHADBOURN, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Beaufort, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the improvement of the water way between Beaufort Harbor and New River, North Carolina, for the fiscal year ending June 30, 1891.

This water way has been in my charge since 10th January, 1891.

Under a contract with the Alabama Dredging and Jetty Company, dated December 24, 1890, dredging operations began February 1, 1891, and continued till March 23, 1891, when the dredge was allowed to be removed to go elsewhere. During this time a cut 3,395 feet long, 40 feet wide, and 3 to 4 feet deep at dead low water was made in Sanders Creek Shoal in extension of the cutting done in 1889. Fourteen thousand seven hundred and seventy-two and seven-tenths cubic yards of material was removed from this cut and deposited from 35 to 40 feet from the edge of cutting to the center of dump. The dumpage was deposited on the north side of the cut from the point of commencement for 1,800 feet, at which point the center line of the present cut was moved 60 feet south, and the dumpage was placed on the south side for the remaining 1,595 feet. This southward movement of the present cut was done partly to give an opening into the cut from the waters and shore to the northward of the cut, and partly also as it was thought the dumpage placed on the south or exposed side of the cut would better protect it; and it is so arranged that the finally complete cut of 100 feet width will be perfectly straight. At the point of change a large basin 100 feet wide was dredged to facilitate vessels passing easily from one cut to the other.

The present funds are sufficient to dredge a single cut of the dredge entirely across this shoal, so as to reach the dredging of former years across Goose Creek Shoals, which will give a continuous channel 40 feet wide with least depth of 3 feet at low water through this water way.

A cut 500 feet long, 50 feet wide, and 5 feet deep at low water was dredged across Sally Bell Shoal excavation, about 1,200 yards of material, but as the contractor did not dredge to the width desired (100 feet), preferring to leave this till he has completed the Sanders Creek Shoal cut, the exact amount was not determined and pay for this dredging was held back.

An examination of all the dredged cuts of previous years was made in February of this year, and they were all found to be in as good condition as when first dredged, and in many places had deepened and widened, while the dumpage bank nearly everywhere has washed down to high-water level.

The expenses incurred under my direction have been:

For superintendence and surveys	$1,072.41
For purchase and repair of plant	43.46
For dredging	3,693.18
Total	4,809.05

There still remains $5,490.95 for the prosecution of this work and about 5,000 linear feet of cutting to be made.

Dredging operations were carried on under the immediate supervision of Inspector Frank D. Perry, who rendered faithful and efficient service.

No new lines of transportation have been established during the year.

Very respectfully, your obedient servant,

W. H. CHADBOURN, JR.,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When placed under governmental improvement in 1886, this water way possessed an 8-inch depth of channel at dead low water from Beaufort to the town of Swansboro, on White Oak River. Over this part of the route the commerce is estimated to have then been about $200,000 per year, carried in sail boats of less than 2-foot draft, using the route during high water. At present its channel has been deepened to a depth of about 2 feet at dead low water and about 3 feet at average water.

The improvement has not yet progressed sufficiently to allow of full expected increase of traffic, as the channel is still incomplete. Rates of freight remain about the same as before, but in consequence of the work already done the total commerce has more than doubled and is now estimated at about $478,200 of goods transported per year.

As soon as this route is fairly opened the lumber industry will probably add from $150,000 to $200,000 per year to the commerce of this water way.

A company is at present being organized to put a small steamboat on the route between Swansboro, Morehead City, Beaufort, and New Berne.

In addition to its local importance this route is a valuable link in the system of inland navigation from the Chesapeake Bay to Wilmington, N. C.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$42,000	....	$42,000	300
Tobacco	....	$5,500	5,500	12
Rice	5,000	....	5,000	140
Grains and forage	2,000	1,000	3,000	620
Vegetables and truck	41,300	....	41,300	400
Live stock and products	10,500	3,000	13,500	300
Fish, oysters, etc	45,000	....	45,000	3,230
Naval stores	15,400	....	15,400	930
Lumber and products	103,000	....	103,000	20,300
Fertilizers	....	11,000	11,000	550
Machinery	....	7,000	7,000	25
General merchandise	....	182,500	182,500	2,500
Sundries	4,000	....	4,000	25
Total	268,200	210,000	478,200	29,332

Gain over last year, $59,800; tons, 11,167.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer W. H. Chadbourn, jr., made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
Commerce at present, as above shown	$478,200	29,332
Commerce before the improvement began	200,000	*12,250
Development of commerce since beginning of the improvement	278,200	17,082
Expended on improvement up to December 31, 1890	14,668	....
Development of annual commerce for every dollar spent on the improvement	19	....

*Estimated.

L 14.

IMPROVEMENT OF WATER-WAY BETWEEN NEW RIVER AND SWANSBORO, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of this water-way see pages 1124–1127 of Annual report for 1889. (For map of same see end of present report.)

(2) *Original condition.*—This water way from New River to Swansboro is an inland route of about 22 miles in length, lying between the sand banks of the ocean shore and the main land behind, and consisting mainly of narrow tide-water creeks running through a broad salt marsh. The marshes vary from 1 to 2 miles in width; the creeks from 12 to 700

feet in width and from 0.6 to 8.0 feet in depth; and the rise of the tide from 0.2 to 5.0 feet, according to location and the prevailing winds.

The value of the improvement lies in the fact that it will open a northern outlet to the New River basin, and that it will form a southern extension to the line of existing light-draft navigation already reaching from New York through the intermediate States to Swansboro, N. C., parallel to and close to the Atlantic Coast Line.

When placed under Governmental improvement in 1890 this waterway possessed a 0.5-foot depth at low water from New River 10 miles to Brown Inlet, thence a 0.5-foot depth 5 miles further to Bear Inlet, and thence a 1.2-foot depth 7 miles further to Bogue Inlet, White Oak River, and Swansboro. At the inlets the depth on the ocean bars is about 3 feet at New River, 3 feet at Bear Inlet, 4 feet at Brown Inlet, and 7 feet at Bogue Inlet. New River can be ascended with 5 feet depth for 17 miles; White Oak River with 3.5 feet depth for 23 miles, and Bogue Sound with 4 feet depth 24 miles to Beaufort, and thence northward. The commerce of the portion from New River to Swansboro, being limited to 2-feet boats at ordinary high tide, was very small and was estimated at about $20,000 (about 3,000 tons) per year.

(3) *Plan of improvement.*—The original project of 1889, as continued to date, proposed to open this route to at least 40 feet width and from 3 to 4 feet depth at high water, from New River to Swansboro, by dredging.

The total final cost of this work was estimated in 1889, at $43,000.

The aggregate amount appropriated for this project up to 30th of June, 1891, is $5,000.

(4) *Results.*—Up to the 30th of June, 1890, no funds had been voted and no work done. No results can be expected before 1892. The navigation of this work is not obstructed by bridges; but since the examination of this route by the Government, private parties have secured charters from the State of North Carolina giving them exclusive rights to its navigation.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the year is as follows: Expenditures, including outstanding liabilities, $509.76. Value of United States plant, $2.

The project for this work was approved in October, 1890, so far as to cover a careful survey of the route where dredging would be necessary; all work of superintendence, survey, office, and minor work to be done by hired labor, and purchase of materials in open market.

Surveys were postponed till spring to await a suitable time for work, and to economize the services of assistants and employés then busy on more important work on neighboring water ways. In April, May, and June, 1891, surveys and maps of this route were in progress under Assistant Engineer W. H. Chadbourn, jr., whose report is appended. These maps will serve for the definite location of the improved route.

This water way being available as yet only for boats of less than 2 feet draft, the commerce is very slight, and practically the same as in 1889, namely, $20,000 (about 3,000 tons) per year.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original project, so as to secure a channel of at least 40 feet width and 3 to 4 feet depth at high tide, from New River to Swansboro, at a total expense of $38,000, in addition to the funds available 30th of June, 1891. It is also spe-

cially recommended that these funds be not made available for use until all rights to exclusive navigation of this water-way be ceded to the United States free of charge by its present charter owners.

For advantageous and economical use the funds should be appropriated in yearly installments of about $15,000 per year. Smaller or irregularly voted appropriations will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of plant, and cost of moving plant over long distances to and from the place of work, and may increase the final cost of the work from $1,000 to $3,000 per appropriation.

The channel once thoroughly cleared should remain fairly permanent.

This water-way is in the collection district of Beaufort, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	484.00
July 1, 1891, balance unexpended	4,516.00
July 1, 1891, outstanding liabilities	25.76
July 1, 1891, balance available	4,490.24
Amount (estimated) required for completion of existing project	38,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. W. H. CHADBOURN, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Beaufort, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the improvement of the water way between New River and Swansboro, North Carolina, during the fiscal year ending June 30, 1891:

This water way has been in my charge since March 18, 1891.

This water way formed originally a part of the water way between Beaufort Harbor and New River, North Carolina, until the river and harbor act of 1890 made a separate appropriation for the portion between New River and Swansboro.

This water way is about 22 miles long, and a greater part of the distance is composed of very crooked and narrow channels through the marshes.

From Swansboro the first 10 miles, passing near Bogue Inlet and directly across Bear Inlet, the channel is from 60 to 1,000 feet wide, carrying from 3 to 10 feet of water at low water everywhere, except one short shoal known as Cow Horn, about 4.4 miles from Swansboro, which has 1.2 feet of water on it.

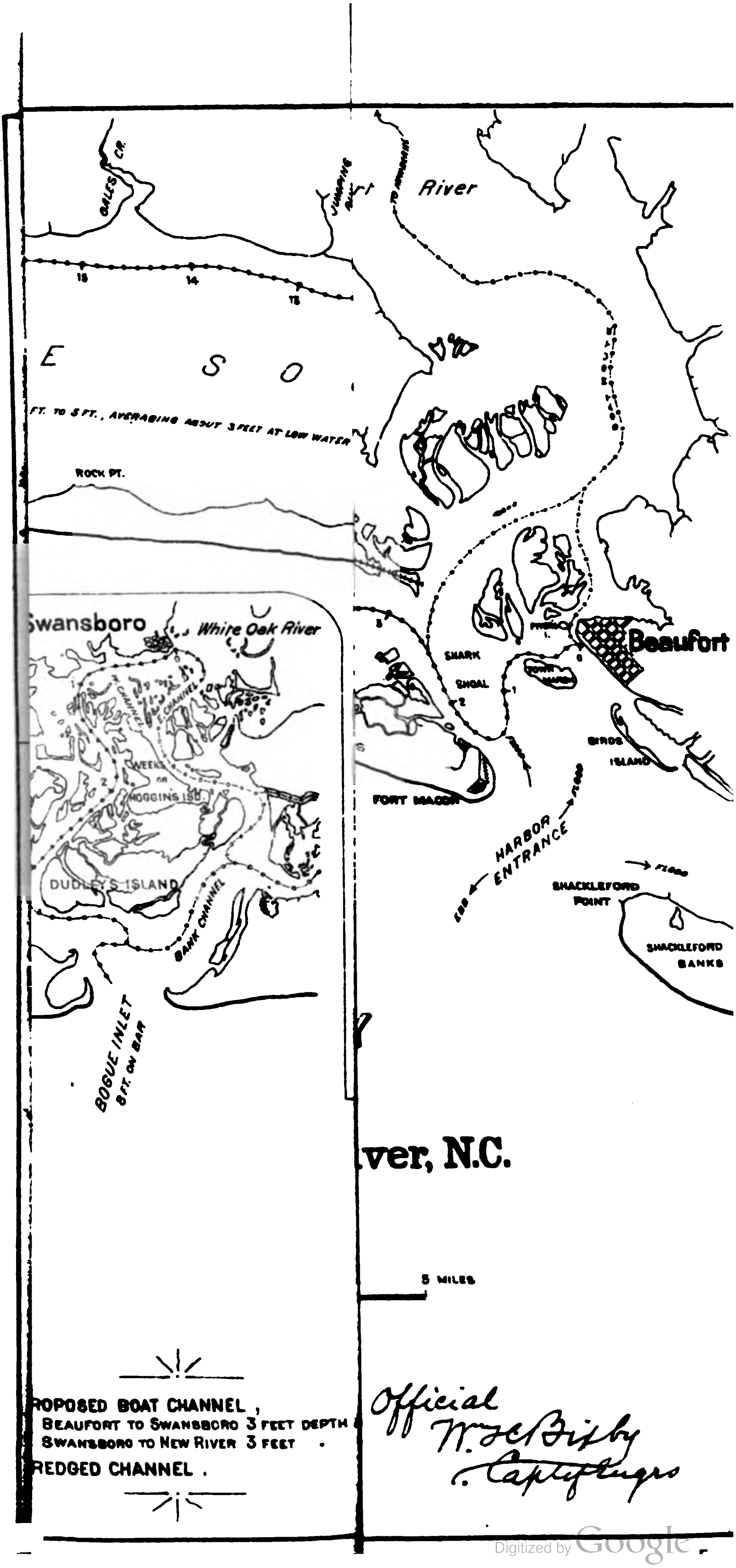
For the next 5 miles the channel is from 60 to 800 feet wide, average about 150 feet, and has from 3 to 12 feet of water at low water, except at a short shoal known as Standback, midway between Bear and Brown inlets, situated at the meeting of the tides from these inlets, which has about 6 inches of water upon it at low water.

For the remaining 7 miles the route is very crooked and the channel in most places from 12 to 60 feet wide, and carrying from one-half to 3 feet of water at low water, the former depth for about 2 miles of the distance.

The ordinary rise of tide for the first 5 miles is about 2.5 feet; for the next 10 miles from 3.5 to 4 feet, and on the remaining 7 miles from 1 to 2 feet, the former depth at the shoalest parts.

During April and May, 1891, surveys were made of all places carrying less than 2 feet at low water, being at the shoal Cow Horn, at Standback, and the 5 miles of the route at the New River end.

The commerce of this route at present is practically nothing, owing to the difficulties boats experience at the shoals; but with, say, 2 feet at low water the commerce would quickly amount to several hundred thousand dollars.



Official
W. C. Bixby
Capt. of Engrs

The expenditures on account of the surveys of this route, under my direction, have been:

For superintendence and surveys	$494.08
For purchase and repair of plant	15.60
Total	509.68

Very respectfully, your obedient servant,

W. H. CHADBOURN, JR.,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

This improvement was not commenced before the 31st December, 1890. At that time the annual commerce is estimated to have been less than $20,000, being limited to that of small sailing boats of less than 1 foot draft, plying between New River and the northern ports.

Two additional appropriations of about $20,000 each would open a passage of 3 feet draft at high tides, sufficient to serve as an outlet for much of the existing $700,000 of commerce of New River, and will probably rapidly develop several more hundred thousand dollars worth of similar commerce, opening up a region of from 60,000 to 100,000 acres of good farming lands, representing a possible annual commerce of from $1,000,000 to $4,000,000.

The present commerce remains the same as that of the 31st December, 1890, estimated at about $20,000 or 3,000 tons; the improvement of this water way being only just commenced.

L 15.

IMPROVEMENT OF NEW RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of this river, see pages 1117, 1118, Annual Report for 1882; for map and special history of past work, see pages 992 and 994, Annual Report for 1886. For map of work completed and proposed, see page 1144 of Annual Report for 1890; and for map of river itself, see this present report.

(2) *Original condition.*—The New River, emptying directly into the Atlantic Ocean between Beaufort Harbor and Wilmington, N. C., has a total length of about 52 miles and a drainage area of 492 square miles. Its lower 21 miles, from its mouth to Jacksonville, forms a fine basin of brackish water of from 500 to 10,000 feet width and of at least 5-feet-channel depth, with 20,000 acres of oyster farms, and with rich agricultural surroundings. When placed under Governmental improvement in 1882 this river had very poor facilities for transporting goods to market. Its communication with the ocean was blocked by an oyster-rock barricade, through which there existed only a long and very crooked channel of 50 feet width and 3 feet depth at low water. Its commerce, limited to wagons and small boats, is now estimated to have then been about $200,000 of goods per year.

(3) *Plan of improvement.*—The original project of 1882 proposed to secure a 150-foot channel, 5 feet deep at low water, from the upper river to the ocean, by dredging the old channel to its full size through about 7,000 feet of this oyster-rock barricade. A personal examination of the

locality in 1885 showed the agricultural richness of the river basin, its pressing need for better transportation facilities, and the worthiness of the improvement.

The total final cost of this work was estimated in 1885 to be $40,000. Inadequate yearly appropriations and their consequences (the alternate disorganization and reorganization of working parties, damage to unfinished works, extra superintendence, and deterioration of plant) may add considerably to this final cost.

The aggregate amount appropriated for this project up to June 30, 1891, is $28,000.

(4) *Results.*—Up to June 30, 1890, a total of $19,188.18, including outstanding liabilities, had been spent in all upon this improvement, replacing the long and crooked channel by a shorter and straighter channel of at least 40-feet-bottom width and 2 to 5 (average 4.5) feet depth at low water.

This new channel was already in daily use by the craft entering New River from the ocean, though its incomplete condition prevents much of its usefulness.

The commerce of the river was then about $700,000 worth of goods transported per year, showing that every dollar once spent upon this improvement had been accompanied by the development of about $29 of annual commerce.

The navigation was not obstructed by any bridges below its present head at Jacksonville.

PRESENT OPERATIONS.

(5) *Work of past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $499.85; value of United States plant, $260.

Owing to its variable features and the difficulty of properly specifying it beforehand, all minor work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

In July, 1890, 400 linear feet of oyster-shell diking was built across the lower mouth of Cedar Point Creek, and 130 linear feet of similar diking was built out from the west side of the lower end of Cedar Bush Marsh cut, both of these with a view to protecting and deepening the half-finished channels dredged in past years.

Contract with the Alabama Dredging and Jetty Company under new appropriations was approved in January, dredging to be commenced by 3d December, 1891, and to be completed before 3d April, 1892.

Inspections of the locality were made during the year.

The ocean bar entrance, which now has a depth of at least 3 feet at low water, appears to be in as permanent and useful condition as at any time during the past 6 years.

The work of this improvement during the year has been under the immediate supervision of Assistant Engineer W. H. Chadbourn, jr., whose report is herewith appended.

Since but little new work has been done during the past year and the past work is in a half-finished condition, the general situation remains about the same as at the commencement of the fiscal year.

The latest commercial statistics, those of the calendar year ending December 31, 1890, are herewith appended, showing a total commerce of about $743,350 or 17,359 tons.

(6) *Recommendations for future work.*—It is recommended that the present adopted project be completed so as to secure a channel of from

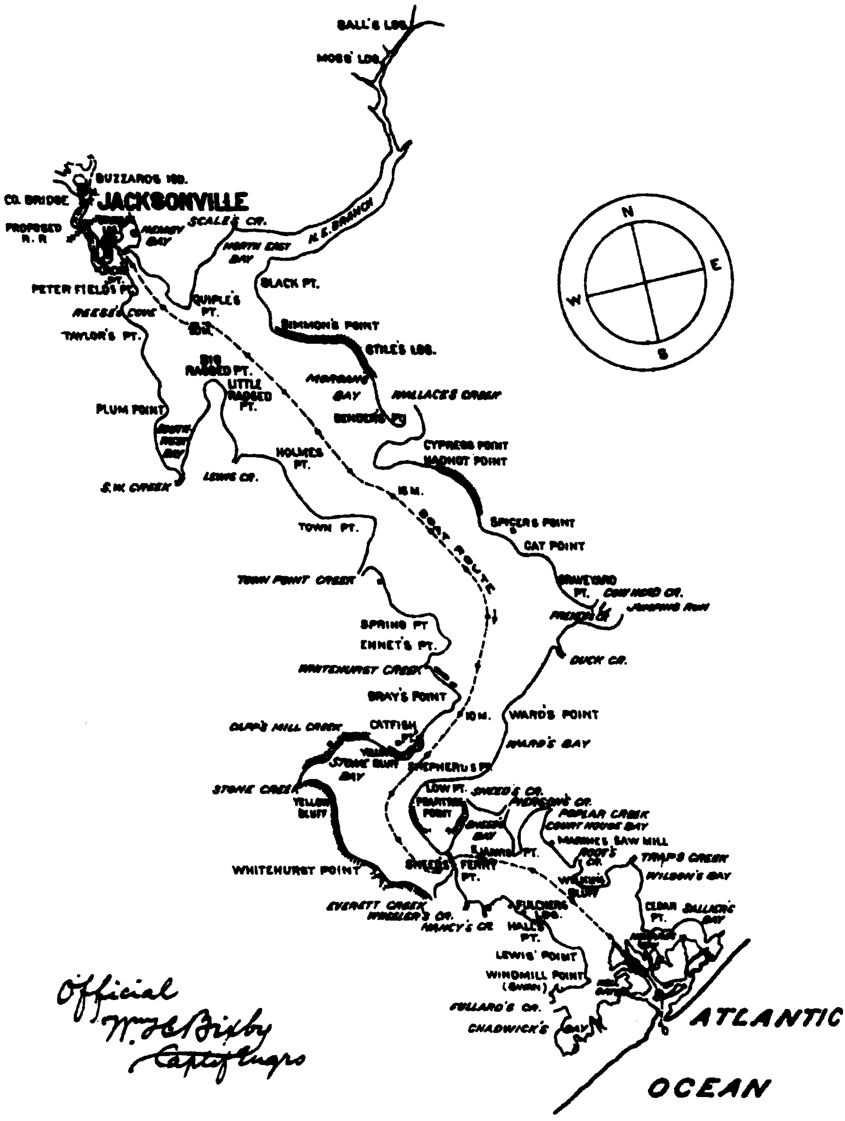
NEW RIVER, N.C.

OCEAN TO JACKSONVILLE

SCALE

1 0 1 2 3 4 5 6 7 8 9 10 MILES

Compiled from sketches made by E.D. Thompson 1880 & A.K. Michler 1876 and from Chart of U.S.C.&G. Survey 1881
Reduced & drawn in office of Capt. W.H. Bixby, Corps of Engineers, U.S.A. by P. Bresig in April 1891.



Official
W. H. Bixby
Capt of Engrs

Eng 91

100 to 150 feet in width and 5-foot depth at low water from the ocean up to the upper river at a total expense of $12,000 in addition to the funds available June 30, 1891, to be appropriated in a single amount within the next year. Smaller yearly appropriations and their consequences, the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and deterioration of plant ,may increase the cost of the work by about $2,000 per appropriation. Further improvement so as to give a channel of greater depth or width is not recommended at present.

This improvement, once thoroughly completed, should be permanent.

This river is in the collection district of Beaufort, N. C.

Money statement.

July 1, 1890, balance unexpended		$4, 253. 69
Amount appropriated by act approved September 19, 1890		5, 000. 00
		9, 253. 69
June 30, 1891, amount expended during fiscal year		910. 65
July 1, 1891, balance unexpended		8, 343. 04
July 1, 1891, outstanding liabilities	$31. 07	
July 1, 1891, amount covered by uncompleted contracts	6, 500. 00	
		6, 531. 07
July 1, 1891, balance available		1, 811. 97
Amount (estimated) required for completion of existing project		12, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		12, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging New River, North Carolina, opened at 12 o'clock m., December 16, 1890, by Capt. W. H. Bixby, Corps of Engineers.

No.	Name and address of bidder.	Price bid.	Remarks.
1	Skinner & Wallace, Wilmington, N. C.	55 cents per cubic yard in place.	Will commence within 10 months 600 yards weekly.
2	Alabama Dredging and Jetty Company, Mobile, Ala.	49 cents per cubic yard in place; to be reduced 10 cents per yard in case awarded two other works.	Within 10 months 1,000 yards weekly.

Amount of dredging bid for, $5,500 to $6,500.

Recommended to be awarded to bidder No. 2, Alabama Dredging and Jetty Company.

There is available for the work of improving New River, North Carolina, the sum of $8,400.

REPORT OF MR. W. H. CHADBOURN, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Beaufort, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations during the fiscal year ending June 30, 1891, on the improvement of New River, North Carolina.

In May of this year I made an examination of the dredged cuts made in former years and of the bar.

The least soundings on the bar at low water were 4 feet. The bar is reported to be in a much better condition than it has been for some time, but it is very changeable and no dependence can be placed on any reports of its condition for any length of time. Wright Island Cut remains about the same as last year, rather improved if anything (the average depth of water now being from 8 to 10 feet at low water), and the shoals at both ends have continued to scour, so that 5 feet at low water can be easily carried through the cut from the bar. All vessels now use this cut, as the old river channel around Wright Island is gradually shoaling.

At Cedar Bush Marsh the cut still has a depth of from 4 to 5 feet at low water, but the upper portion has continued to shoal (about 2 feet at low water) so that vessels are unable to use it. This shoaling occurs in the portion of the cut where the outlet sloughs have not been closed by dumpage. At the south end of the cut the bar, formed probably by an eddy tide, has about 3 feet of water at low water on it. The jetty built across Cedar Point Creek at the southern end of Cedar Bush Marsh has prevented any further trouble there.

A contract has been made with the Alabama Dredging and Jetty Company for about $6,500 for dredging in New River, but they have until December 1, 1891 to commence because of other work by the same company in the neighborhood. With this money it is intended to remove the oyster-rock obstructions in the open river above the cut and also widen and deepen the cut, making it useful to navigation although it will still be quite narrow for a considerable part of its length.

No new lines of navigation have been established during the year. A light-draft steamer was in use by an oyster company (recently established on the river) and another is under construction for the same company.

This business is getting to be an extensive one on this river.

The expenses under my directions have been:

For superintendence	$28.
For construction and repair of plant	13.
Total	41.

Very respecefully, your obedient servant,

W. H. CHADBOURN, JR.,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Previous to the commencement of work in 1882 the commerce of this river is estimated to have been about $200,000 per year.

The commerce is estimated at present to be at least $700,000 of goods transported per year, carried on mainly in sailing vessels with the ports of Baltimore, Philadelphia, Wilmington, N. C., Charleston, S. C., Beaufort and New Berne, N. C.

Rates of freight have decreased 15 to 20 per cent. since 1882, and each dollar so far spent upon this improvement has been accompanied by the development of $ annual commerce.

A large overland commerce is carried on with Wilmington and New Berne, the exports consisting mainly of fish, oysters, naval stores, and vegetables. A great portion of this commerce of necessity passes over a part of the river. A new railroad just completed from Wilmington to New River will tend to largely increase the fish and oyster business.

The completion of the improvement will give a nearly straight channel from to 150 feet wide and at least 5 feet deep at low water through the marshes from the open water of the river direct to the ocean.

The drawback to navigation during past years has been the uncertain condition of the bar at the river entrance, but its present condition promises better for the future.

The resources of this section have been but little developed. The manufacture of lumber should become a leading industry and add from $150,000 to $200,000 to the annual commerce.

The river has heretofore been the only means by which the products of this section could be carried to market without great expense.

The commerce for the year ending 31st December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$123,750	....	$123,750	1,350
Tobacco	....	$15,000	15,000	30
Rice	1,000	....	1,000	22
Grains and forage	7,200	....	7,200	562
Vegetables and truck	20,900	....	20,900	800
Live stock and products	25,000	115,000	140,000	800
Fish, oysters, etc	124,000	....	124,000	2,600
Naval stores	71,500	....	71,500	3,145
Lumber and products	38,000	....	38,000	5,900
Fertilizers	....	1,000	1,000	50
General merchandise	....	200,000	200,000	2,000
Sundries	....	1,000	1,000	100
Total	411,350	332,000	743,350	17,359

Gain over last year, $11,800; tons, 3,197.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer William H. Chadbourn, jr., made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	*Amount.	Tons.
The commerce at present as above shown is	$743,350	17,359
The commerce before the improvement began was	200,000	5,000
The development of commerce since beginning of the improvement is	543,350	12,359
Expended on improvement up to 31st December, 1890	19,611	....
The development of annual commerce for every dollar spent on the improvement is	28	....

*Estimated.

L 16.

IMPROVEMENT OF NORTH EAST (CAPE FEAR) RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of this river see pages 1181–1184 of Annual Report for 1890; and for map of same see House Ex. Doc. No. 35, Fifty-first Congress, first session.

(2) *Original condition.*—The North East Cape Fear River, joining the Northwest (or main) Cape Fear River at Wilmington, has a total length of about 130 miles and a drainage area of about 1,600 square miles. Over its lower 50 miles it is subject to tides.

When placed under governmental improvement in 1890 this stream possessed a depth of from 6 to 30 feet at low water from Wilmington upward 50 miles to near Bannermans Bridge, easily navigable by small steamers carrying two flats abreast; thence 40 miles farther, to near Hallsville, it had a depth of about 3 feet at ordinary stages of water; thence 13 miles farther up to Kornegays Bridge it had a depth and width suited only to pole boats and rafts. Everywhere above Bannermans Bridge it was badly obstructed by snags and by overhanging, leaning, and fallen trees, so as to completely block navigation at all ordinary stages of water. Its steamboat commerce was then estimated at about $270,000 (about 41,000 tons).

(3) *Plan of improvement.*—The original projects of 1889, as continued to date, proposed the removal of all obstructions, such as snags, and overhanging, leaning, and fallen trees, stumps, etc., so as to thoroughly clear a channel of good width and natural depth for small light-draft steamboats up to Hallsville and for pole boats up to Kornegays Bridge.

The total final cost of this work was estimated in 1889 at $30,000.

The aggregate amount appropriated for this project up to the 30th of June, 1891, is $5,000.

The funds now on hand will be used up before new appropriations become available.

(4) *Results.*—Up to 30th of June, 1890, no appropriations had been voted for this work. Consequently no work had been done and no benefits received. No results can be expected before 1892.

The river is obstructed by one railroad bridge without a draw below Chinquapin, and three county bridges without draws above this point. The railroad is now at work rebuilding its bridge with a draw, and the three county bridges will probably insert draws as soon as the navigation is improved up to their neighborhood.

PRESENT OPERATIONS.

(5) The special work of the year is as follows: Expenditures, $3,173.60, including outstanding liabilities; value of United States plant, $160.

Project was approved in October, 1890, for the expenditure of funds voted by act of Congress of 19th of September, 1890; all funds to be spent for snagging and bank trimming, including cutting away of projecting points of bank at sharp bends, occasional blasting, water-gauge observations, minor surveys, and office and minor work.

Owing to its variable features and the difficulty of properly specifying it beforehand and inspecting and measuring it up afterwards, this work, for advantage and economy, was allowably done by hired labor and purchase of materials in open market.

In December, 1890, minor surveys were made at bridges, and eight water gauges were established.

From January to April, 1890, one steam hoister and the necessary flats and equipment (borrowed from the other Cape Fear improvements) were at work snagging, their work being very much impeded by freshets and high water. From 31 miles of river, from Bannerman's Bridge to Chinquapin (79 miles from mouth of river) there were removed 145 cords of brush and 216 trees, cut and pulled back from the banks; and 213 trees, 126 stumps, 189 logs, and 90 cords small snags from the channel, clearing the river generally to at least 40 feet width and to its natural depth. This work was so laid out as to be of the greatest possible immediate benefit to navigation.

Water gauges are kept at eight points on the river.

A small reserve has been kept for contingencies and for a little special work to be done at low water.

The work of this improvement during the year was well carried forward under the immediate supervision of Assistant Engineer Charles Humphreys, whose report is herewith appended.

The work of the past year has already much benefited navigation, allowing light-draft steamers to go 56 miles up the river (to Croom's Bridge) all the year, thence 18 miles farther (to Deep Bottom Bridge) during about 9 months of the year, and thence 5 miles further (to Chinquapin) during from 6 to 8 months of the year; all these places being important shipping points during the busy seasons. (The next appropriations will roughly clear the river to the next shipping point, Hallsville, and will more thoroughly improve the river below Chinquapin.)

This work is of too recent date to have affected the commerce, which remains practically about the same as in 1889. The latest commercial statistics, those for the year ending December 31, 1889, are herewith appended showing a commerce of about $270,000 (about 41,000 tons) per year.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original and approved project, so as to thoroughly clear the river channel to its natural width and depth up to Kornegays Bridge, at a total expense of $25,000 in addition to the funds available June 30, 1891; this amount to be appropriated in yearly installments of about $10,000. Smaller or irregularly voted appropriations will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of plant and extra cost of moving plant over long distances, and may increase the final cost of work from $1,000 to $3,000 per appropriation.

After this improvement is finished, its proper maintenance may cost from $1,000 to $2,000 per year.

This river is in the collection district of Wilmington, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	3,133.60
July 1, 1891, balance unexpended	1,866.40
July 1, 1891, outstanding liabilities	40.00
July 1, 1891, balance available	1,826.40
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER

UNITED STATES ENGINEER OFFICE,
Fayetteville, N. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report on Cape Fear River, North Carolina (North East River), for the fiscal year ending June 30, 1891.

The operations in field have been as follows:

The river has been cross-sectioned, and gauges established at Castle Hayne, Bannerman's, Croom's, Deep Bottom, Chinquapin, Hallsville, Sarecta, and Kornegay's, and records kept since the middle of December, 1890.

A steam hoister (belonging to the Upper Cape Fear River) was borrowed for this work, and after being repaired (adding also a hinge arrangement for lowering the A frame to pass under bridges) started up the river from Wilmington on January 20, 1891 (the *Oklahoma* doing the towing), arriving at Bannerman's Bridge, 48 miles above Wilmington, on January 21, 1891. Snagging was begun at this point and worked up to Chinquapin, 79½ miles above Wilmington, roughly clearing the channel and banks of the worst obstructions to a high-water navigation, the total expense to date being $2,884.63.

On the 24th of April the hoister returned to Wilmington for work on the Cape Fear River above Wilmington.

It is proposed to spend the balance of the available funds, $615.37, in continuing the gauge records, noted above, throughout the calendar year, and during the low-water season to go over the river again with the hoister, making a more thorough cleaning wherever needed below Chinquapin. A week's work below Bannerman's would be beneficial, besides the work between Bannerman's and Chinquapin.

This work will allow light-draft steamers to reach Crooms Bridge throughout the year, Deep Bottom Bridge 9 months per year, and Chinquapin 6 to 8 months per year.

The amount of work done is as follows:

Banks:	
Brush, cords cut	145
Trees cut down and hauled back	216
Channel:	
Trees hoisted	213
Stumps hoisted	126
Logs hoisted	189
Cords snags hoisted	90

The work thus far done, though distributed over a considerable length of unimproved river, with a comparatively small sum of money, is still of great benefit to the navigation interested.

Mr. D. S. Bender has rendered good work as overseer of the hoister.

Mr. John A. Dill relieved me of the work May 25, 1891. Value of plant is $13.67. It is in good order.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

The work of this improvement was not begun until after December 31, 1890. At that time the river navigation was restricted to a tolerably good 6 feet draft over the lowest 50 miles of the river, and allowed nothing but occasional boats at especially high water on the next 53 miles above.

The river commerce at that time was estimated at about $270,000 of actual commerce.

The present annual commerce of the entire river basin, which may come down the river as soon as it is thoroughly cleaned, is estimated at $819,000, or 60,000 tons.

The actual present annual river commerce remains the same as in November, 1889, the improvement of the river being of too recent a date to have produced any effect thereon.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$13,000		$13,000	65
Vegetables and truck	4,000		4,000	4
Naval stores	122,000		122,000	2,6
Lumber and products	104,000		104,000	35,64
Fortilizers	10,000		10,000	25
General merchandise		$17,000	17,000	2,0
Total	253,000	17,000	270,000	40,5

Gain over last year, nothing

Transportation lines established during year, none.

The work of improvement did not commence until 1891.

The above statistics are based mainly upon reports of Capt. W. H. Bixby, made after much correspondence and conversation with steamboat captains and agents, custom-house officials and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present as above shown is	$270,000	40,000
The commerce before the improvement began was	270,000	40,000
Expended on improvement up to December 31, 1890	316	

L 17.

IMPROVEMENT OF BLACK RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of river and obstructions, see pages 1145–1154, Annual Report for 1885.

(2) *Original condition.*—The Black River, North Carolina, a tributary of the Cape Fear River, has (with its own main tributary, South River) a total length of about 175 miles, and a drainage area of about 1,547 square miles.

When placed under governmental improvement, in 1886, this stream possessed a moderately well-cleared channel from its mouth (in the Cape Fear River, 15 miles above Wilmington) 22 miles upwards to Point Caswell, with 2.5 feet depth at low water and 4 feet depth at high tide; thence a roughly cleared navigation 48 miles farther to near Lisbon, with 2.5 feet depth during 9 months per year, and with 6 feet depth during 6 months per year. A steamer of 2.5-foot draft was regularly running once or twice per week all the year to Point Caswell, and 9 months per year to Clear Run (about 7 miles below Lisbon). The commerce (including rafted goods) is estimated to have been $750,000 per year.

(3) *Plan of improvement.*—The original project of 1885 as continued to date proposed to secure a thoroughly cleared channel of natural depth over the 70 miles of river from its mouth to near Lisbon, and afterwards a 4-foot channel at low water below Point Caswell.

The total final cost of this work was estimated in 1885 at $33,500. Inadequate yearly appropriations and their consequences (the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and deterioration of plant) may add considerably to this final cost.

The aggregate amount appropriated for this project up to June 30, 1891, is $3,000.

(4) *Results.*—Up to June 30, 1890, a total of $2,896.85, including outstanding liabilities, had been spent in all upon this improvement in the removal of the worst obstructions over the entire river. All private claims to the exclusive navigation of this river had been annulled by the State of North Carolina. In consequence of this work, steamboats had been enabled to run with increased certainty and regularity. The commerce was then about $1,200,000 of transported goods per year, showing that each dollar spent upon this improvement since its commencement has been accompanied by the development of about $140 of annual commerce. The navigation was not obstructed by bridges without draws.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $140; value of United States plant, nothing.

The available funds were entirely insufficient for effective work on this river, and work was mainly confined to office duties and minor field work. A small reserve fund was retained for use in emergencies and for incidental work.

Owing to the variable nature of the work, the difficulty of specifying it beforehand and of measuring it afterwards, the work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

Inspections of property were made during the year.

Water gauges were established in November, 1889, at four points on the river and have been kept continuously ever since.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a present annual commerce of $945,514 (about 61,311 tons).

(6) *Recommendations for future work.*—The river is far from being properly cleared and there is an urgent need for more work to put the stream in thoroughly good order. It is recommended: That this improvement be completed so as to secure, first, a fairly cleared natural channel over the entire river from its mouth up 70 miles to near Lisbon, then a 4-foot channel below Point Caswell, and then an improved channel through the Narrows, at a total expense of $30,500 in addition to the funds available on June 30, 1890; this amount to be appropriated in yearly installments of as much as $20,000 each until complete. Smaller yearly appropriations will involve the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, deterioration of plant, and may increase the expense from $2,000 to $4,000 per appropriation. Further improvement so as to secure a 6-foot depth of channel below Point Caswell is not recommended at present.

After this improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

The river is in the collection district of Wilmington, N. C.

Money Statement.

July 1, 1890, balance unexpended	$121.48
Proceeds of sale	39.45
	160.93
June 30, 1891, amount expended during fiscal year	155.00
July 1, 1891, balance unexpended	5.93
July 1, 1891, outstanding liabilities	3.33
July 1, 1891, balance available	2.60
Amount (estimated) required for completion of existing project	30,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Fayetteville, N. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report on Black River, North Carolina, for the fiscal year ending June 30, 1891.

Owing to the small amount of funds available the operations have been confined to keeping water gauges at Port Caswell, Mill Creek Landing, and Hampton, during July, and at these places and Clear Run during the remainder of the calendar year.

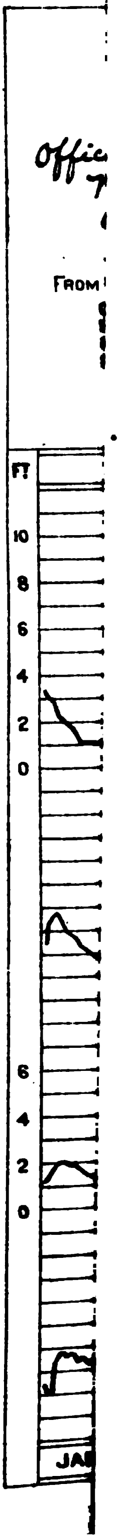
Navigation has been closed a considerable portion of the year on account of low water, logs, and other obstructions waiting removal, so that a good deal of the country produce has been hauled in wagons to the nearest railroads.

Mr. John A. Dill relieved me of the work on the 25th of May, 1891.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.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COMMERCIAL STATISTICS.

When work was commenced, in 1885, on this improvement the river was navigable for narrow 2.5-foot draft steamers all the year 22 miles, to Point Caswell, and 9 months of the year 41½ miles further, to Clear Run, within 7 miles of Lisbon, the head of the river. One steamer ran regularly over the route. The commerce is estimated to have then been about $750,000 per year.

The rates of freight and insurance have not as yet been appreciably affected by the improvement.

The commerce of the river basin is about the same as in 1885, but a greater proportion of it now goes by steamers than at that time.

The present river commerce is now estimated at $945,514. The small amount of funds so far spent have been of great value to the river navigation, and a few thousand dollars more at the present moment would be also of great immediate advantage to navigation.

There are now two steamers of 2.5 to 3.5 feet draft, 60 tons capacity, making semi-weekly trips to Clear Run for 9 to 10 months per year, and one steam flat, 40 tons capacity, making three trips per week to Point Caswell, and about 20 flats of 30 to 40 tons capacity each towed irregularly a part of the year to Point Caswell by one launch. No great increase of commerce is expected until the improvement above Point Caswell is completed. This river is the main and natural outlet of Sampson County. Its improvement will place much woodland in good communication with a market, and should add $500,000 to its commerce.

The decrease of this commerce this year is in great part due to the specially low water and the specially bad obstructions thus exposed, and the failure of last Congress to provide funds for their removal.

The commerce for the year ending 31st of December, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$24,160	....	$24.160	115
Tobacco	....	$8,000	8,000	18
Rice	8,000	7,200	15,200	240
Grains and forage	....	6,800	6,800	300
Vegetables and truck	6,400	....	6,400	60
Live stock and products	17,400	28,800	46,200	500
Fish, oysters, etc	....	720	720	3
Naval stores	516,000	....	516,000	11,000
Lumber and products	133,314	....	133,314	45,588
Fertilizers	....	2,400	2,400	75
Machinery	....	4,000	4,000	8
General merchandise	....	181,200	181,200	3,400
Sundries	1,120	....	1,120	4
Total	706,394	239,120	945,514	61,311

Decrease over last year, $236,429; tons, 14,327.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer Charles Humphreys, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present, as above shown, is	$945,514	61,311
The commerce before the improvement began was	750,000	*48,650
The development of commerce since beginning of the improvement is	195,514	12,660
Expended on improvement up to 31st December, 1890	2,969	....
The development of annual commerce for every dollar spent on the improvement is	65	....

*Estimated.

L 18.

IMPROVEMENT OF CAPE FEAR RIVER, ABOVE WILMINGTON, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of river, see pages 742–749, Annual Report for 1872; for list of present shoals and obstructions, see pages 999, 1000, Annual Report of 1886; for map of river and jetties, see page 1086, Report of Chief of Engineers for 1889.

(2) *Original condition.*—The Cape Fear River above Wilmington has a total length of about 400 miles and a drainage area of 7,167 square miles, of which 5,620 square miles lie above the mouth of the Black River, its main tributary. At Fayetteville, the present head of navigation, 115 miles above Wilmington, the river varies from 112 feet breadth, 16 inches average depth, 150 square feet cross section, 1 mile per hour current, and 200 cubic feet discharge per second in extreme droughts, up to 1,400 feet breadth, 50 feet maximum depth, 7 miles per hour velocity, and 350,000 cubic feet discharge per second in high freshets. Ordinary low water usually lasts from 1 to 4 months per year, and 15-foot stages of water at Fayetteville are usually reached once a month during the rest of the year.

When placed under governmental improvement in 1881 this stream was navigable during the 9 flush-water months of the year from Wilmington 115 miles upward to Fayetteville; but the channel for the upper 75 miles was badly obstructed by sunken logs, snags, overhanging trees, and shoals; and for the upper 66 miles it was full of shoals on which there was not more than 12 to 14 inches of water during the low-water season. At that time the navigation was owned by private parties. Its commerce is estimated to have been about $800,000 of goods transported per year.

(3) *Plan of improvement.*—The original project of 1881–'82, as continued to date, proposed to buy out the private owners of the river, then to clear out its natural obstructions, and to further provide a continuous channel over its upper 66 miles by dredging and by artificially contracting its water way by jetties through at least 32 shoals.

The total final cost of this work was estimated in 1885 at $480,000 for a 3-foot actual channel depth during 11 or 12 months of the year up to Fayetteville. There appears every probability that this expenditure will finally give the expected improvement, and that the commerce will be increased by that time to $4,000,000 of goods per year.

The aggregate amount appropriated for this work up to June 30, 1891, is $103,250.

(4) *Results.*—Up to June 30, 1890, a total of $87,971.26, including outstanding liabilities, had been spent in all upon this improvement, giving a moderately good continuous 4-foot channel at least 100 feet wide during the entire year from Wilmington, 46 miles, to Kelly's Cove; thence a similar 3-foot channel 27 miles farther to Elizabethtown (a place of considerable commerce), and thence a 2-foot channel at least 80 feet wide 42 miles farther to Fayetteville during 11 months of the year, increased to 5-foot draft from Wilmington to Fayetteville during 10 months of the year.

In consequence, three permanently established steamboat lines had been running over the entire distance with full draft for 10 months each year, and with lessened draft the rest of the time. The commerce during these years has increased about $200,000 per year; had been further benefited by exemption from tolls, and was then about $2,500,000 of transported goods per year, showing that each dollar once spent on this improvement had been accompanied by the development of about $20 of annual commerce.

The navigation of this stream was not obstructed by bridges without draws between Wilmington and Fayetteville.

PRESENT OPERATIONS.

(5) *Work of the past year*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $6,379.17; value of United States plant, $5,520.

After new funds became available high water prevented river work until April, 1891.

During the working season one steam launch and hoister, four stone flats, and other plant were employed on the river.

Owing to its varied features and the difficulty of specifying it beforehand and measuring it afterward, the work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

In February to May two flats were built for the towage of stone, and two others were borrowed from the Lower Cape Fear River.

During the months of February to June, inclusive, there was quarried 1,558 cubic yards of stone at McArthurs (121 miles above Wilmington), and 233 cubic yards at Browns (49 miles above Wilmington).

Of this stone, 100 cubic yards were towed to and deposited at McCarters Cross Shoal (114 miles above Wilmington); 460 cubic yards to McRaes Cross Shoal (110½ miles above Wilmington); and 499 cubic yards to Thames Shoal (102 miles above Wilmington).

During April, May, and June the snagging plant worked over 27 miles of river (from 22 to 30, 65 to 68, and 99 to 115 miles above Wilmington), removing from the banks 119 trees (cut and pulled back) and 105 cords of brush, and from the channel 52 trees, 32 stumps, 42 logs, and 26 cords of small snags, leaving the channel in excellent condition over this distance.

During the entire working season work was greatly interfered with by high water.

During the remainder of the year work has been confined to office duties and minor work.

Water gauges were kept at two places during the year.

Inspections of plant and work were made during the year.

The work of this improvement has been well and vigorously prosecuted under the immediate supervision of Assistant Engineer Chas. Humphreys, whose report is herewith appended.

The work of the past year has maintained the existing fair navigable condition of the river. The effect of the jetties so far constructed has been to better the channel at all formerly worst places, so that now low-water navigation is possible during fully 11 months of the year.

The bridge of the Cape Fear and Yadkin Valley Railroad at Fayetteville (mentioned in Appendix M 11, Annual Report of Chief of Engineers for 1889) has been completed and been built in such a way as not to interfere with navigation; but a coffer dam around one of its piers still remains to be removed (awaiting low water).

Otherwise the general situation is about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year endi December 31, 1890, are herewith appended, showing a commerce o $2,014,436 per year, about 129,000 tons.

(6) *Recommendations for future work.*—Were the commerce of th river sufficiently large to justify the expenditure of such an amoun in my opinion the proper method of improving this river would be b the construction of suitable dams and locks of 32 feet total lift, givin a 6-foot navigation at all times of the year to Fayetteville, at a tot approximate cost of $1,200,000. A commerce sufficient to justify suc an expenditure can not be expected from this locality for many year Consequently the lock-and-dam navigation must be postponed for th present, and a contracted river channel must be accepted as the be under the circumstances.

It is recommended, therefore, that this improvement be completed in accordance with the present approved and adopted project, so as to secure a thoroughly cleared 4-foot channel from Wilmington to Elizabethtown; thence a similar 3-foot channel to Fayetteville during 11 or 12 months of the year, at a total expense of $376,750 in addition to the funds available June 30, 1891; this amount to be appropriated in yearly installments of as much as $60,000 until complete. Small yearly appropriations, involving the alternate disorganization and reorganization of working parties, damage to unfinished work, deterioration of plant, and extra superintendence, may increase the cost of the work from $1,000 to $4,000 per appropriation. Further improvemen so as to extend the navigation above Fayetteville, or so as to increas the depth below Fayetteville, is not recommended.

After this improvement is completed its proper maintenance may cos from $1,000 to $3,000 per year.

This river is in the collection district of Wilmington, N. C.

Money statement.

July 1, 1890, balance unexpended	$359.3
Amount appropriated by act approved September 19, 1890	15,000.0
	15,359.3
June 30, 1891, amount expended during fiscal year	5,288.2
July 1, 1891, balance unexpended	10,070.9
July 1, 1891, outstanding liabilities	1,171.5
July 1, 1891, balance available	8,899.7
Amount (estimated) required for completion of existing project	376,750.0
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.0

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. JOHN A. DILL, OVERSEER.

UNITED STATES ENGINEER OFFICE,
Fayetteville, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the improvement of the Cape Fear River, North Carolina, above Wilmington, for a portion of the fiscal year ending June 30, 1891.

In accordance with instructions from your office, this work has been under my immediate charge since 25th May, 1891, upon which date I relieved Assistant Engineer Charles Humpreys.

Mr. Humphreys's report, already forwarded, contains a summary of all work done on this river up to the 25th day of May, 1891. Since that day the work has be done as follows:

PROGRESS MAP FOR 1891

CAPE FEAR RIVER ABOVE WILMINGTON, N.C.

FROM 1 JULY 1890 TO 30. JUNE 1891.

SHEET
Nº 2

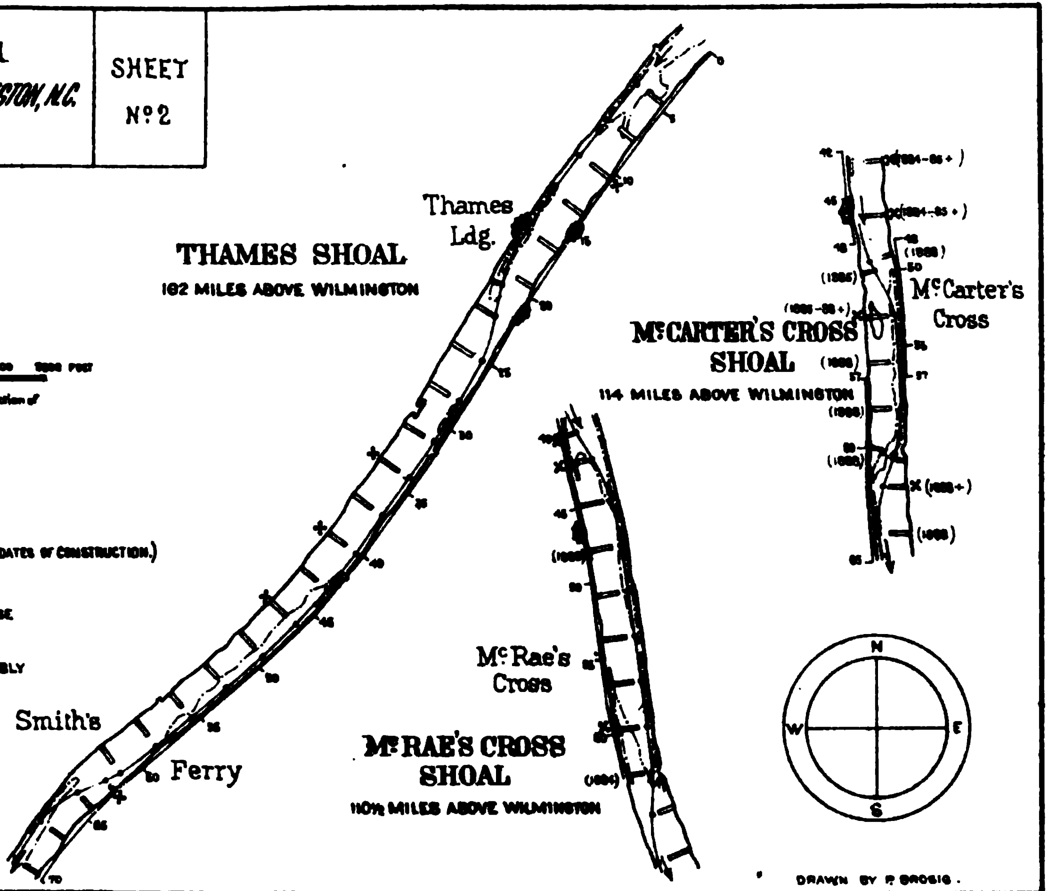
JETTIES

SCALE

0 200 400 600 800 1000 1200 1400 1600 1800 2000 FEET

Based on surveys of Chas. Humphreys (1888-90) made under direction of Captain W. H. Bixby, Corps of Engineers, U. S. A.

- SHORE LINE
- 3 FT DEPTH AT LOW WATER
- SURVEY LINE AND STATIONS
- CENTRE OF PROPOSED CHANNEL
- JETTIES BUILT OR PROPOSED (WITH DATES OF CONSTRUCTION.)
- —WORK DONE DURING FISCAL YEAR 1890-91 —
- ROCK PILED ON SHORE FOR FUTURE USE IN BUILDING NEIGHBORING JETTIES
- × JETTIES WHERE ROCK WILL PROBABLY BE PLACED NEXT YEAR



Wilmington, N.C. July 1891

Respectfully submitted

W. H. Bixby

CAPTAIN OF ENGINEERS

Eng 91

From the quarry at McArthurs (6 miles above Fayetteville, N. C.), 1,059 cubic yards of stone have been towed downstream and placed at the following points:

At McCarter's Cross, 100 cubic yards; at McRae's Cross, 460 cubic yards; at Thames, 499 cubic yards.

Have cut 69 cords of brush for jetty mattresses.

The hoister has worked whenever the stage of water would permit, has snagged over 16 miles of river, removing from channel 8 trees, 13 stumps, 14 logs, 7 cords small snags, and from bank 14 leaning trees, and cut 4 cords of brush.

The towing was done by the steam launch *H. G. Wright*.

An engine and boiler was borrowed from the Yadkin River for use at the stone quarry, lowering stone to scows on the river.

Borrowed from the Cape Fear River, North Carolina, below Wilmington, two scows for use in towing stone. Ordinary repairs to plant were made when necessary.

Very respectfully, your obedient servant,

JOHN A. DILL,
Overseer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Fayetteville, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report on the improvement of the Cape Fear River, North Carolina, above Wilmington, for the fiscal year ending June 30, 1891.

The operations for the past year have been as follows:

The steam hoister belonging to this work was repaired in January, 1891, and lent temporarily to the North East River, returning from that work April 24 and proceeding at once with the snagging of the Cape Fear River above Wilmington.

The steam launch *H. G. Wright* returned from the northeastern part of the State the 8th of May and immediately began the work of towing the hoister and other boats upstream and making preparations for rock towing, bringing up two borrowed flats from the Lower Cape Fear River. February 6, 1891, a small force began quarrying rock at McArthur's (6 miles above Fayetteville). April 15 another small force began quarrying rock at Brown's Reach (70 miles below Fayetteville). Two small flats were built in February and March.

Operations in the field to May 20 were as follows:

Quarried 810 cubic yards of rock; hauled to bank 1,028 cubic yards of rock; snagged over 10⅜ miles of river, removing from channel 44 trees, 19 stumps, 28 logs, 19 cords small snags, and from bank 105 leaning trees and 101 cords of brush. Cut down 35 cords of wood for steamboat fuel.

The steam launch *H. G. Wright* has been fitted up and repaired generally for the season's work. The work has been greatly impeded by high water.

During the past year there were plying on this river 2 stern wheel steamers, 4 tug boats, and 41 flats.

The Cape Fear and Yadkin Valley Railroad has caused a still further reduction in the river commerce between Fayetteville and Wilmington, but the steamboat commerce along this river is gradually increasing.

During the past year navigation was closed on account of low water for 4 days.

I was relieved of this work on the 25th of May by Mr. John A. Dill.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced, in 1881, the river was badly obstructed and only navigable 9 months of the year, and the navigation was owned by a private corporation. The commerce is estimated to have then been about $800,000 per year. At present the river is fairly well cleared of obstructions (logs, trees, etc.), is navigable all the year for light-draft boats, and for 5-foot draft steamers during at least 11 months of the year. Steamers now run regularly, making 4 round trips per week. The commerce is now $2,014,436 per year, and with Black River commerce (which also goes over part of this river) is about $2,960,000. The commerce of the Cape Fear River above Wilmington is carried by steamers and flats as follows: The *Murchison* of about 150 tons capacity, *Cape Fear* 150 tons, and the *Hurt* 90 tons. These steamers have each two 150-ton flats, and there are about 13 other flats on the river averaging about 60 tons capacity each. The steam tugs *Marie*, *Pet*, *Lawrence*, and launches *Navassa*, *Ida*, *Louise*, and *Dude* are employed part of the year in towing.

The rates of freight have been reduced about 33 per cent, and river insurance is regarded as unnecessary except against fire. The commerce has increased over $180,000 per year on an average ever since work began, in 1881. Every dollar so far spent upon the improvement has been accompanied by the development of about $20 of annual commerce. In addition to this the former tolls have been removed. There is every indication that with a never failing depth of 3 feet throughout the entire year the commerce would gradually increase to $4,000,000 or more per year, including rafted goods.

The falling off of the commerce this year is caused by the completion of the Cape Fear and Yadkin Valley Railroad which has temporarily taken much of the commerce that had heretofore come over the river.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$320,000	$11,200	$331,200	1,65
Tobacco	10,360	19,200	29,560	66
Rice	14,914	11,930	26,844	62
Grains and forage	1,600	16,800	18,400	51
Vegetables and truck	8,860	....	8,860	5
Live stock and products	30,400	120,000	150,400	1,6
Fish, oysters, etc	16	3,600	3,616	15
Naval stores	440,000	....	440,000	24,15
Lumber and products	163,594	....	163,594	62,0
Fertilizers	....	240,000	240,000	7,5
Machinery	31,627	....	31,627	12
General merchandise	51,335	424,000	475,335	18,9
Sundries	4,175	90,825	95,000	11,3
Total	1,076,881	937,555	2,014,436	129,

Decrease over last year, $503,609; tons, 21,000.

Transportation lines established during year, none.

The above statistics are based mainly upon reports of Assistant Engineer Chas. Humphreys, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Amount.	Tons.
The commerce at present as above shown is	$2,014,436	129,000
The commerce before the improvement began was	800,000	*50,000
The development of commerce since beginning of the improvement is	1,214,436	79,000
Expended on improvement up to December 31, 1890	88,040	....
The development of annual commerce for every dollar spent on the improvement is	20	....

* Estimated.

L 19.

IMPROVEMENT OF CAPE FEAR RIVER, AT AND BELOW WILMINGTON, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For maps of river, see page 1050, Annual Report for 1887, and 1090 of 1885; for special history of past work, see page 1004, Annual Report for 1886; for last projects, see pages 1132-1134, Annual Report for 1889.

(2) *Original condition.*—The Cape Fear River, emptying into the Atlantic Ocean at Cape Fear, has, from its mouth up to its head waters in the mountains, a total length of about 426 miles and a drainage area of 9,115 square miles. The two main branches of this river meet at Wilmington, bringing with them an average fresh-water discharge of 14,000 cubic feet per second. Below Wilmington the river is a tidal basin, with about 26 miles length, 350 square miles drainage area, 37 square miles water surface, 3.5 feet rise of tide (2.5 at Wilmington, 4.5 at the ocean), and an average discharge during ebb of 160,000 cubic feet per second, the ocean bar being 2 miles seaward of the river mouth.

When placed under improvement, in 1829, this stream had 3 bar entrances, with least depths as follows: About 9 feet at the Baldhead Channel, 9 feet at the Rip Channel, and 10 feet at New Inlet Channel, these bars being respectively 9, 6, and 2 miles below the point which was then the head of the river's delta. From the head of this delta, 20 miles up to Wilmington, there were several shoals with a least depth of 7.5 feet at low water. The commerce in 1827 is unknown, but that of 1870 was about $13,500,000, of which $1,500,000 was foreign export.

(3) *Plan of improvement.*—The original projects of 1827 to 1847 proposed to improve the upper 20 miles by dredging and by jetty contraction of the channel; $203,204.59 were spent during this time in increasing the depth upon the shoals to 9.5 feet at low water, equal to that at the bar entrances. At or about this time the shore at Fort Caswell, opposite Baldhead Point, was protected by stone jetties, under an appropriation for the preservation of fortifications.

The projects of 1852 to 1857 proposed to deepen the water at the main entrance by jetties at Baldhead Point, and by jetty and dike obstructions between Zeke Island and Smith Island, near New Inlet, and suggested the possible future necessity of closing New Inlet; $156,296.26 was spent during this time upon these works, never fully completed for want of funds.

The project of 1870 proposed a crib-closure of the space (4,403 feet long) between Smith and Zeke Island (finished in 1873) to prevent further widening of New Inlet. The projects of 1870 to 1872 proposed the complete closure of New Inlet (begun in 1875 and finished in 1881), in order to deepen the water at the main (Baldhead) bar entrance. The projects of 1872 to 1883, as continued to date, proposed the extension of the New Inlet Dam 2 miles further down the stream, to prevent the further erosion of Smith Island at the Swashes. The project of 1875, as continued to date, proposed the occasional use of dredging upon the outer bar to assist the tidal currents in gradually localizing, straightening, deepening, and fixing the bar entrances, to obtain, first, a 12-foot depth at low water, and then a 14-foot depth. The projects of 1874 to 1881 for the 20 miles above New Inlet, as continued to date, proposed dredging and occasional diking wherever necessary across shoals, so as to secure, first, a 12-foot channel 200 feet wide, and afterward a 16-foot channel 270 feet wide at low water over this whole length.

The total final cost of this work under the projects of 1870 to 1889 was, in 1889, estimated to be $3,930,000.

The aggregate amount appropriated for the existing projects of 1872 to 1889 was, up to June 30, 1891, $2,275,000.

The project of 1889 extended the work of the proposed improvements to obtain a depth of 20 feet at low water from Wilmington to the ocean, at a total increased cost of $1,800,000.

(4) *Results.*—Up to June 30, 1890, a total of $2,093,885.87, including outstanding liabilities, had been spent in all upon the proposed improve-

ment of 1870 to 1889 with great success, obtaining a 16-foot least depth of water at the main bar entrance, and completing a channel of 16 feet depth and at least 233 feet width 28 miles further to Wilmington. This depth, combined with the average rise of tide of 4.5 feet at the bar and 2.5 feet at Wilmington, is such that at that time vessels loaded to 18 feet draft (10.5 feet more than in 1827) could readily go from Wilmington to the ocean in a single tide any day of the year.

The total commerce, exports and imports, foreign and coastwise, had increased from about $13,500,000 of transported goods in 1870 up to about $20,000,000 in 1890, and its foreign exports alone from $1,500,000 in 1871 to about $8,000,000 in 1890, showing that each dollar once spent on this improvement has already been accompanied by the development of about $3.30 of annual foreign commerce, although the last increase of 2 feet in draft in the river channel was too recent to have produced its natural effect on such development.

The navigation of this river below Wilmington is not obstructed by bridges of any sort.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $65,708.74; value of United States plant, $22,300.

During the year one United States steam tug, one United States steam-suction dredge, and other United States plant were in use.

From January to June, 1891, there were employed from one to two contract dredges on the improvement.

Owing to its variable nature and to the difficulty of properly specifying it beforehand and measuring it afterwards, all work except dredging was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market. The dredging was done partly under contract dated December 24, 1890, with P. Sanford Ross, of Jersey City, N. J., to be finished by February 14, 1892, and partly by hired labor by the United States steam-suction dredge *Woodbury.*

All work done under contract was performed in a very thorough and highly satisfactory manner. The contractor employed the following-named dredges, and removed from the various shoals of the river 291,671 cubic yards mud and sand, and 20 logs, viz:

Name of dredge.	Mud and sand.	Logs.
	Cubic yards.	
No. 5	96,675	2
Pugh	149,996	18
Total	291,671	20

During the fiscal year the *Woodbury*, operated by hired labor and the purchase of materials in open market, removed 64,553.4 cubic yards of mud and sand, at a total cost of $9,561.74, or 0.1481 cents per cubic yard. Between June 30 and October 14, 1890, and between December 22, 1890, and June 30, 1891, she was kept at work on the ocean bar (29 miles below Wilmington). Between the same dates, but during weather unsuited for work on the bar, she worked on Snows Marsh Channel (20 miles below Wilmington).

Between October 14 and December 22, 1890, the *Woodbury* was loaned to the Governmental improvement of the St. Johns River, Florida.

The total work of all the above-mentioned dredges during the year is as follows:

From the ocean bar (29 miles below Wilmington) there were removed 54,716 cubic yards of mud and sand, leaving a channel of 200 feet width and about 16 feet depth at low water.

From the New Snow's Marsh Channel (20 miles below Wilmington) there were removed 18,645.4 cubic yards of mud and sand, leaving the cut everywhere 233 feet wide and 16 feet deep at low water.

From Old Brunswick Cove Shoal (13 miles below Wilmington) there were removed 37,828 cubic yards of mud and sand, leaving the cut everywhere 270 feet wide and 16 feet deep at low water.

From Lilliput Shoal (11 miles below Wilmington) there were removed 101,768 cubic yards of mud and sand, leaving the cut everywhere 140 feet wide and 16 feet deep at low water.

From Alligator Creek Shoal (1 mile below Wilmington) there were removed 48,865 cubic yards of mud and sand, leaving the cut of partial width and 20 feet depth at low water.

From Wilmington Shoal (opposite the city) there were removed 94,402 cubic yards of mud and sand, and 20 logs, leaving the cut of partial width and 16 feet deep at low water.

On October 15, 1890, the steam tug *Easton* lost all her upper works by a fire whose origin was without any known cause. From that time until June, 1891, she was under repairs.

Minor surveys were made at various times during the year to determine the condition of the ocean bar and dredged channels.

Inspections of property and work were made during the year, showing very satisfactory results everywhere.

The work of this improvement has been vigorously and very thoroughly carried on under the immediate supervision of Assistant Engineer Henry Bacon, until his death in April, 1891 (by which the United States lost an especially efficient and valuable assistant). Since then the work has been well carried on by Acting Superintendent Robert Merritt, whose report is herewith appended.

The work of the past year has greatly benefited the navigation of the river. In the upper river the channels are everywhere of full depth, and vessels drawing 18 feet have safely ascended and descended the river, and one drawing over 20 feet has safely crossed the ocean bar.

The single straight channel on the ocean bar has been maintained, and its depth increased by natural scour and by the work of the United States section-dredge *Woodbury*.

The foreign commerce is steadily increasing. Otherwise the situation remains about the same as at the beginning of the fiscal year.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of about $21,447,320 per year (about 346,557 tons).

(6) *Recommendations for future work.*—It is recommended that the above improvements be carried on by widening and deepening the existing river channels to their full dimensions of 270 feet width and 20 feet least depth at low water, and by straightening, deepening, and fixing the bar entrance, at a total expense of $1,655,000, in addition to the funds available June 30, 1890, to be appropriated in amounts of $300,000 per year. Smaller yearly appropriations, involving the alternate disorganization and reorganization of working parties, damage to unfinished work, deterioration of plant, and extra superintendance may increase the cost of the work by from $6,000 to $20,000 per appropriation.

After this improvement is finished its proper maintenance may cost from $5,000 to $25,000 per year for a few years, but the improvement should be fairly permanent.

This river is in the collection district of Wilmington, N. C.

Money statement.

July 1, 1890, balance unexpended		$13,476.04
Proceeds of sale		60.00
Amount appropriated by act approved September 19, 1890		170,000.00
		183,536.04
June 30, 1891, amount expended during fiscal year		55,423.42
July 1, 1891, balance unexpended		128,112.62
July 1, 1891, outstanding liabilities	$12,647.23	
July 1, 1891, amount covered by uncompleted contracts	85,953.59	
		98,600.82
July 1, 1891, balance available		29,511.80
Amount (estimated) required for completion of existing project		1,655,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging Cape Fear River at and below Wilmington, N. C., opened at 11 o'clock a. m., December 15, 1890, by Capt. W. H. Bixby, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.	Will commence.
		Cents.	
1	Atlas Dredging Company, Wilmington, Del	15	February 1, 1891.
2	Alabama Dredging and Jetty Company, Mobile, Ala	13⅛	January 1, 1891.
3	P. Sanford Ross, Jersey City, N. J	13¼	January 15, 1891.
4	Moore & Wright, Portland, Me	14	May 1, 1891.
5	Geo. C. Fobes & Co., Baltimore, Md	13⅞	April 1, 1891.
6	Baltimore Dredging Company, Baltimore, Md	14⅜	February 1, 1891.
7	National Dredging Company, Wilmington, Del	14	April 1, 1892.

$110,000 to $125,000 worth of dredging bid for.

Recommended to be awarded to bidder No. 3, P. Sanford Ross.

There is available for the work of improving Cape Fear River at and below Wilmington, N. C., the sum of $173,000.

REPORT OF MR. ROBERT C. MERRITT, ACTING SUPERINTENDENT.

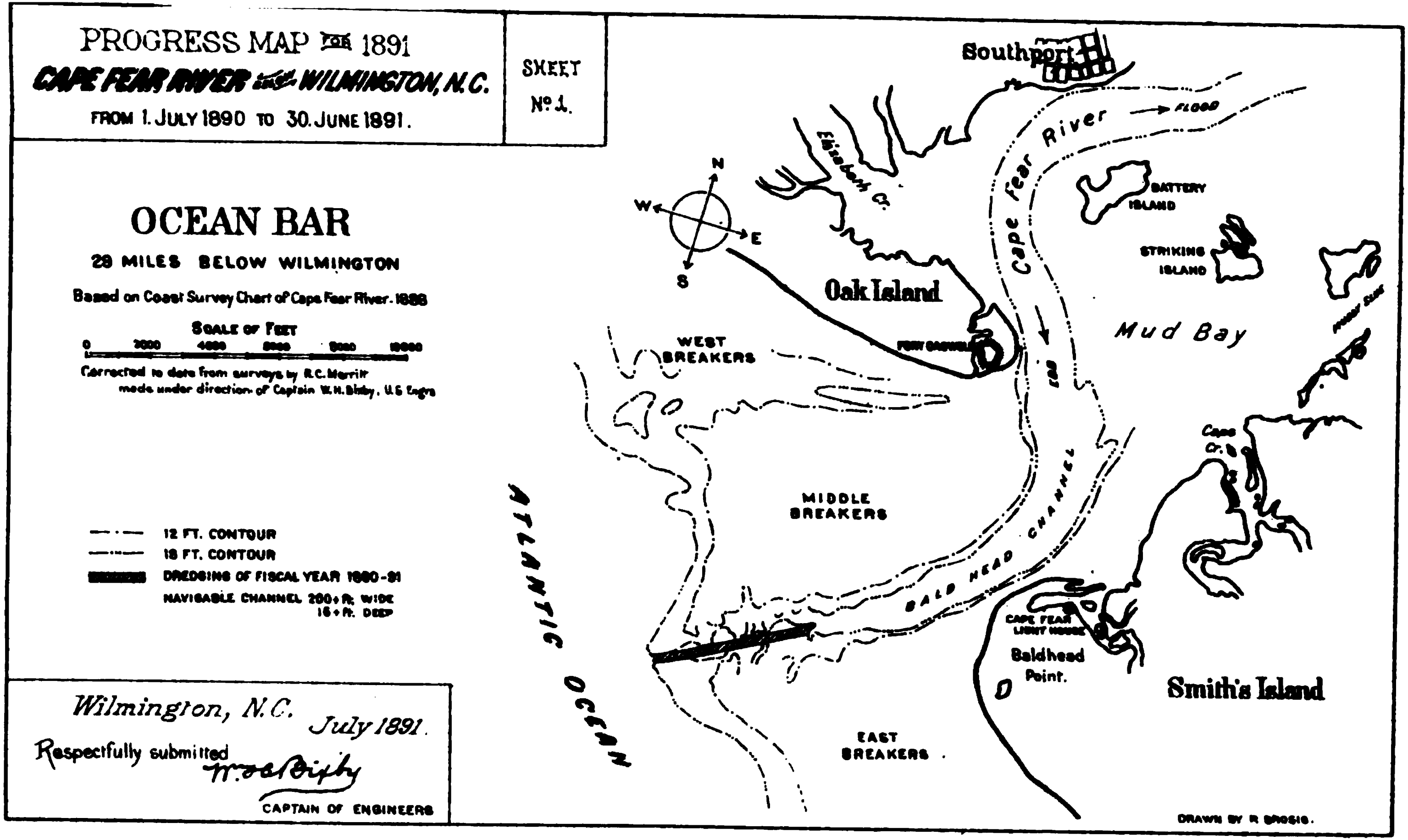
UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Cape Fear River, North Carolina, at and below Wilmington, for the fiscal year ending June 30, 1891.

At the beginning of the fiscal year the appropriation of August 11, 1888, was nearly exhausted.

The work under the new appropriation of September 19, 1890, was delayed by the necessary time taken for advertising and making a contract for the work, and time needed by the contractor after the award was made to prepare for work; thus under contracts of the fiscal year actual dredging has been carried on only during the last 6 months.

The operations on this river improvement have been contract dredging; operations of the Government suction-dredge *Woodbury*, repairs of steamer *Easton* (which was badly damaged by fire on the night of October 15, 1890), and other minor repairs and work.



PROGRESS MAP FOR 1891

CAPE FEAR RIVER AT & BELOW WILMINGTON, N.C.

FROM 1. JULY 1890 TO 30. JUNE 1891.

SHEET
Nº 1.

OCEAN BAR

29 MILES BELOW WILMINGTON

Based on Coast Survey Chart of Cape Fear River. 1888

SCALE OF FEET
0 2000 4000 6000 8000 10000

Corrected to date from surveys by R. C. Merritt
made under direction of Captain W. H. Bixby, U. S. Engrs

- — · — 12 FT. CONTOUR
- —·—·— 18 FT. CONTOUR
- ▬ DREDGING OF FISCAL YEAR 1890-91

NAVIGABLE CHANNEL 200+ ft. WIDE
16+ ft. DEEP

Wilmington, N.C. *July 1891.*

Respectfully submitted
W. H. Bixby
CAPTAIN OF ENGINEERS

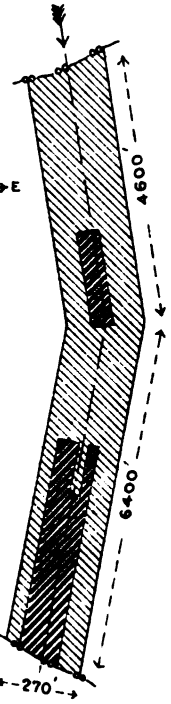
Eng 91

PROGRESS MAP FOR 1891
CAPE FEAR RIVER BELOW WILMINGTON, N.C.
FROM 1. JULY 1890 TO 30. JUNE 1891.

SHEET
No. 2.

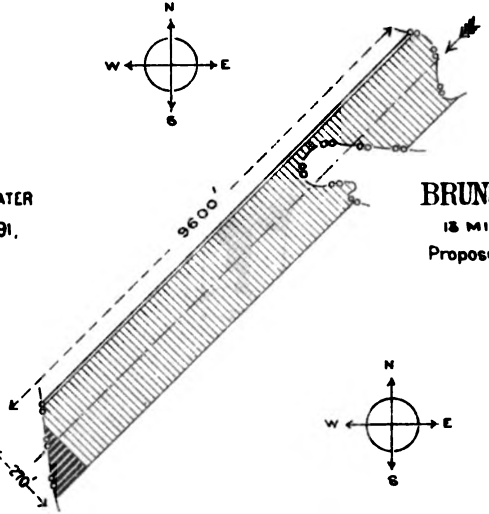
LILLIPUT SHOAL

11 MILES BELOW WILMINGTON
Proposed Channel : 11000 ft. long
270 ft. wide
16 ft. deep



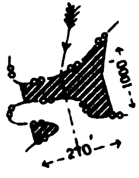
NEW CUT OPPOSITE SNOW'S MARSH CHANNEL

20 MILES BELOW WILMINGTON
Proposed Channel : 9600 ft. long
270 ft. wide
16 ft. deep

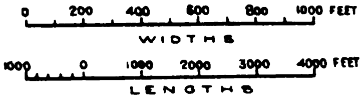


OLD
BRUNSWICK COVE SHOAL

13 MILES BELOW WILMINGTON
Proposed Channel : 1000 ft. long
270 ft. wide
16 ft. deep



Scales



ALL DREDGING IS TO BE CARRIED TO A DEPTH OF 16 FEET AT LOW WATER

▨	DREDGING OF FISCAL YEAR 1890-91.
▧	CHANNEL ALREADY COMPLETED
☐	UNCOMPLETED CHANNEL
—oo—	NATURAL DEPTH OF 16 FEET

Wilmington, N.C. *July 1891*

Respectfully submitted W. H. Bixby

CAPTAIN OF ENGINEERS

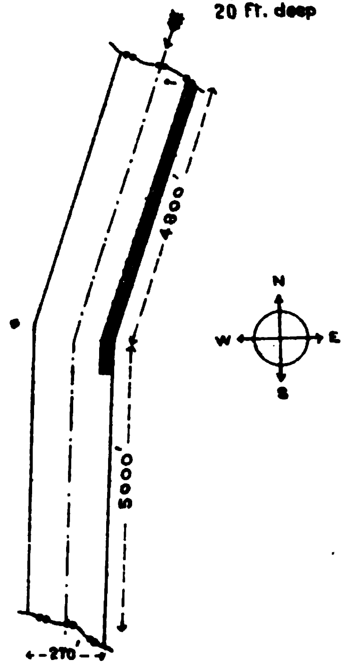
DRAWN BY R. BROSIG.

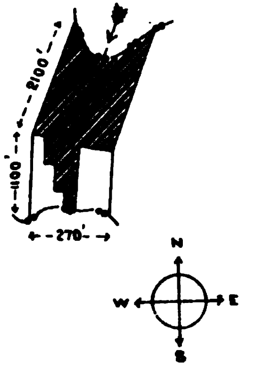
PROGRESS MAP FOR 1891

CAPE FEAR RIVER [illegible] WILMINGTON, N.C.

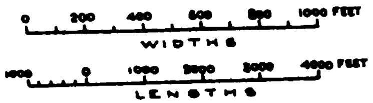
FROM 1. JULY 1890 TO 30. JUNE 1891.

SHEET
Nº 3.





Scales



ALL DREDGING IS TO BE CARRIED TO A DEPTH OF 20 FEET AT LOW WATER

- ■ DREDGING OF FISCAL YEAR 1890-91.
- ☐ UNCOMPLETED CHANNEL
- —●●— NATURAL DEPTH OF 20 FEET

Wilmington, N.C. July 1891

Respectfully submitted Wm. H. Bixby

DRAWN BY P. BROSIS.

The dredging in the river was the beginning of the latest project, which contemplates the final completion of an available channel of 270 feet width and 20 feet depth, at mean low water, from Wilmington downward 30 miles to the ocean.

The repairs of the steamer *Easton* were begun in December and completed sufficiently so that the boat could be used during the month of June. The total cost of the repairs have been, up to the present time, $2,760.28.

The suction dredge *Woodbury* was used outside of this river by Capt. W. M. Black, Corps of Engineers, from October 14 to December 22, 1890, to dredge at or near the mouth of the St. Johns River, Florida.

Upon the Cape Fear River the operations of the *Woodbury* have been on the Baldhead Channel (at the bar), when the weather permitted, and at other times at the New Cut opposite Snows Marsh.

The following is a tabular statement of the work done and the cost of the same per cubic yard and cost in gross, allowing $100 per month for deterioration of plant. The accounts made for the year amount to $9,561.74 and 64,553.4 cubic yards, making the cost $14\frac{81}{100}$ cents per cubic yard. Without allowing for deterioration the cost is 0.1339 cents per cubic yard.

Month.	Cubic yards of dredging done, and number of days dredged.				Total.		Cost.	
	Days.	Bar.	Days.	New cut opposite Snows Marsh.	Days.	Yards.	Whole cost.	Per yard.
1890.								
July	8	3,243.5	11	3,322.8	19	6,566.3	$921.24	$0.1403
August	12	4,270.6	7	1,469.5	19	5,740.1	904.84	.1576
September	18	7,139.9	2	359.0	20	7,498.9	990.74	.1321
October	2	715.8	......	....	2	715.8	510.93	.7138
December	2	1,006.2	3	352.4	5	1,358.6	279.48	.2057
1891.								
January	17	7,394.7	3	704.7	20	8,099.4	962.57	.1188
February	13	5,449.6	6	1,124.9	19	6,574.5	932.38	.1418
March	11	4,060.6	2	202.0	13	4,262.6	984.54	.2310
April	11	4,177.3	4	535.1	15	4,712.4	947.88	.2011
May	21	10,847.2	1	175.2	22	11,022.4	1,055.28	.0957
June	13	6,410.6	4	1,591.8	17	8,002.4	1,071.86	.1339
Total	128	54,716.0	43	9,837.4	171	64,553.4	9,561.74	*.1481

* Average.

The results of the dredging at the bar are gratifying. At the outer crest or bar, over a width of 200 feet, the least depth is 18.1 at mean low water. There are some inner shoals about 3,000 feet inside of the bar where the available depth at low water does not exceed 17 feet.

The principal work, however, in progress on this river is the dredging of a channel to 270 feet width and 20 feet depth at mean low water across all the shoals from Wilmington to Southport Harbor. This work was advertised under date of November 6, 1890, and proposals opened December 15, 1890. Contract was awarded and entered into with P. Sanford Ross at 13¼ cents per cubic yard, under date of December 24, 1890, and approved January 8, 1891.

Work was begun with one dredge January 19, on Lilliput Shoal, and with another dredge on March 16, on the Old Brunswick Cove Shoal, and was diligently prosecuted by these two powerful clam-shell dredges to June 3, and since then by one.

The upper reach, Wilmington Shoal, has been finished to full width and depth, and on the lower reach one cut 38¼ feet wide has been finished and two other cuts, each 38¼ feet wide, partly finished.

At the Alligator Creek Shoal, where the work is now in progress, one cut 37 feet wide has been dredged to 20 feet depth at low water to 500 feet below the angle.

At the Lilliput Shoal some repairs have been made, taking three cuts through the upper reach and four cuts through the lower reach, each 37 feet wide and 16 feet deep at low water.

The Old Brunswick Cove Shoal has been finished to 270 feet width and 16 feet depth at mean low water.

At the New Cut opposite Snows Marsh, a very narrow shoal having formed across the lower end, it was found necessary to have it removed and a supplementary agreement was made with P. Sanford Ross to remove the same. After working against many disadvantages they succeeded in dredging three cuts across the shoal, each 37 feet wide and 18 feet deep at mean low water.

The work done under contract and supplementary agreement may be stated as follows:

Cubic yards dredged.

At Wilmington Shoal	94, 402
At Alligator Creek Shoal	48, 865
At Lilliput Shoal	101, 708
At Old Brunswick Shoal	37, 828
New Cut opposite Snows Marsh	8, 868
Total	291, 671

and 20 logs were removed.

The shore line of Federal Point and its extension over the Carolina Shoals remains in much the same condition as at last report.

The southerly swash (or Corncake Inlet), which 4 years ago had a width of 1,600 feet at high water is now closed and a high beach built up in its place. The other two swashes, New Inlet, Zeke Island, and the long line of beaches extending from Zeke Island to Baldhead or Smith Island remain in comparatively the same condition as at the report of last year.

Some change has occurred in the shore line at Baldhead Point. The accretion on the sea side and at the point has continued, while there has been some erosion at the inner hook. No great changes have occurred in the shore line of Oak Island. There has been some erosion at the point and along the shore opposite Fort Caswell, and some accretion further westward towards Oak Island light-house.

Several detailed hydrographical surveys have been made of Baldhead Channel and vicinity and one survey each of all the dredged channels and a survey of river in front of Wilmington.

The new inlet dam and the long new dam extending from the southerly end of it to the large marsh remain in substantially the same finished condition as last year.

The amount of appropriation by Congress (beginning with $100,000, June 11, 1870, and ending with $170,000, September 19, 1890) is $2,275,000.

The following is the estimate of amounts probably required to complete the present project, including the amount available July 1, 1891. This estimate is slightly modified from that of last year:

525,000 cubic yards dredging, at 13¼ cents	$69, 562. 50
4,121,000 cubic yards dredging, at 15 cents	618, 150. 00
180,000 tons of stone in jetty, at $2.50	450, 000. 00
Two new suction dredges	90, 000. 00
Operating the same 24 months, at $1,750 per month	84, 000. 00
Operating the *Woodbury* 24 months, at $1,000 per month	24, 000. 00
10 per cent. for office expenses and superintendence	133, 571. 25
10 per cent. for contingencies	133, 571. 25
Total	1, 602, 855. 00

I am indebted to Col. John L. Cantwell, secretary of the Produce Exchange and Chamber of Commerce of Wilmington, for his valuable assistance in obtaining the commercial statistics for the year 1890, which have been already forwarded.

A tracing will be submitted with this showing the hydrography of the Baldhead Channel.

The work is in the collection district of Wilmington, N. C. The nearest light-houses are at Baldhead Point and Oak Island, at the mouth of the river.

Very respectfully, your obedient servant,

ROBT. C. MERRITT,
Acting Superintendent.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When the work of this improvement was begun in 1829 the river navigation was restricted to vessels of 7½ feet draft.

At present the river is used by vessels of 17 feet draft; its commerce is about $21,500,000 per year and is steadily increasing.

The rates of freight have greatly decreased since the improvement was begun; the rates of insurance have decreased to such an extent that while formerly there was a discrimination against Wilmington in favor of other southern ports, now Wilmington is put on an equality with Charleston and Savannah.

The foreign commerce has increased from $1,500,000 in 1871 to about $8,170,000 in 1890.

The development of this port directly tends to the development of North Carolina and of such of the Western States as can reach Europe most quickly by the existing and projected North Carolina railroads, the Cape Fear River, and the ocean.

The present commerce is reported as follows:

Commerce, foreign and domestic, for the years ending December 31, 1889 and 1890.

EXPORTS.

Articles.	Quantity.		Rate.		Value.		Tonnage.
	1889.	1890.	1889.	1890.	1889.	1890.	1890.
Cotton ....bales..	132,994	154,666	$51.62½	$52.00	$6,865,815	$8,042,632	38,667
Spirits turpentine, barrels..............	61,626	70,285	21.56	18.70	1,328,657	1,314,330	17,571
Crude turpentine, barrels..............	18,171	19,082	1.49	1.99	27,075	37,973	2,862
Rosin........barrels..	351,827	385,523	.94	1.09	330,717	420,220	57,828
Tar ....do....	68,865	71,949	1.56	1.47	107,429	105,765	10,792
Pitch ....do....	5,269	5,315	1.60	1.60	8,430	8,504	797
Peanuts ....bushels..	80,302	73,121	1.00	1.40	80,302	102,369	1,024
Lumber.........feet..	40,289,205	40,065,567	.01½	$.01\frac{3}{10}$	604,338	520,852	70,115
Shingles ...number..	7,316,912	8,935,064	$.00\frac{6}{10}$	.00½	43,901	44,675	2,234
Miscellaneous (estimated)	....	....	....	....	3,500,000	3,500,000	46,667
Totals..........	....	....	....	....	12,896,664	14,097,320	248,557

IMPORTS.

	1889.	1899.	Tonnage.
Miscellaneous (estimated)..	$7,350,000	$7,350,000	98,000

TOTAL EXPORTS AND IMPORTS.

Total commerce, 1890	$21,447,320	346,557
Gain over last year	1,200,656	21,045

One steamship line was established between Wilmington and Georgetown, S. C., during the year.

The above statistics are based mainly upon reports of Acting Superintendent Robt. C. Merritt, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Value.	Tonnage.
The commerce at present as above shown is	$21,447,320	346,557
The commerce before the improvement began is unknown, but in 1870 was....	13,500,000	220,000
The development of commerce since beginning of the improvement is	8,147,320	126,557
Expended on improvement up to December 31, 1890..............	2,104,767	....
The development of annual commerce for every dollar spent on the improvement is	3.87	....

Statement of vessels of 100 tons and over at the port of Wilmington, N. C., for the years ending December 31, 1889 and 1890.

	1889.		1890.	
	Vessels.	Tons.	Vessels.	Tons.
American	232	115,933	223	104,493
Foreign	153	75,097	169	86,487
Total	385	191,030	392	190,980

Entrances, clearances, and vessels documented for years ending December 31, 1889 and 18

	1889.	18
Entrances, foreign	153	16
Clearances, foreign	161	17
Entrances, American	232	[illegible]
Clearances, American	240	[illegible]
Vessels documented	61	[illegible]

Tonnage.

Vessels.	Foreign.		American.		Total.	
	1889.	1890.	1889.	1890.	1889.	1890
Steamers	26,697	30,161	72,743	64,751	99,440	94,91
Barks	41,354	48,256	507	376	41,861	48,6
Brigs	4,883	5,837	1,233	2,508	6,116	8,34
Schooners	2,163	2,233	41,450	36,858	43,613	39,
Total	75,097	86,487	115,933	104,498	191,030	190,9

The above tables as to entrances, clearances, and tonnage embrace only vessels of 100 tons and upward. No record has been kept of numerous smaller vessels, whose tonnage may be estimated at least 20,000 tons.

L 20.

IMPROVEMENT OF LOCKWOOD'S FOLLY RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *References to past reports.*—For special description of this river and location of proposed channels see pages 1099–1102 of Annual Report of 1887.

(2) This river, emptying directly into the Atlantic Ocean south of Cape Fear, has a length of about 50 miles and a drainage area of about 180 square miles. When placed under governmental improvement in 1890 it possessed a depth of about 3 feet at low water (8 feet at high water) upon its ocean bar; thence about 8 feet depth at low water for about 1.5 miles; thence only about 1 foot depth at low water for about 400 feet; thence from 3 to 6 feet at low water for 1.5 miles; and thence from 5 to 8 feet at low water for 22 miles up to Lockwood's Folly Bridge. Above the bridge the river is only suitable to pole boats, which might carry merchandise 15 miles further. Its river commerce was then estimated at about $50,000 (about 7,000 tons), being limited to light draft steamers, two of which endeavor to make weekly trips to Wilmington. though often detained by unfavorable tides and the oyster-rock barriers.

(3) *Plan of improvement.*—The original project of 1887, as continued to date, proposed to dredge through the oyster rocks and mud flats so as to secure a 6-foot navigation at low water from the ocean upward 25 miles to Lockwood's Folly town bridge.

The total final cost of this work was estimated in 1887 at $40,000.

The aggregate amount appropriated for this project up to June 30, 1891, was $5,000.

The funds now on hand will be used up before new appropriations become available.

(4) *Results.*—Up to June 30, 1890, no appropriations had been voted for this work, consequently no work had been done and no benefits received. No results can be expected before 1892.

PRESENT OPERATIONS.

(5) The special work of the year is as follows: Expenditures, including outstanding liabilities, $19.81; value of United States plant, nothing.

Project was approved in October, 1890, for the expenditure of funds voted by act of Congress of September 19, 1890; all funds to be spent towards dredging a channel of 100 feet width and 7 feet depth at low water across the oyster rock barriers near the mouth of the river, including surveys, water-gauge observations, and office and minor work; the dredging to be done by contract, but all superintendence and minor work by hired labor and the purchase of materials in open market.

Contract was approved in February, 1891, with the Atlas Dredging Company, of Wilmington, Del., for dredging to be commenced by the 16th of April, 1891, and finished in 3 months; the time of commencement being afterwards allowably postponed until the 1st of September, 1890.

Since no work has yet been commenced upon this improvement, the commerce has not changed much from that of 1887, being still estimated at about $50,000 (about 7,000 tons) per year.

(6) *Recommendations for future work.*—It is recommended that this improvement be completed in accordance with the original and approved project so as to secure a channel of 100 feet width and 7 feet depth at low water from the mouth of the river up to the Lockwood's Folly town bridge, at a total expense of $35,000 in addition to the funds available the 30th of June, 1891; this amount to be appropriated in installments of about $10,000 per year. Smaller or irregularly voted appropriations will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of plant, and the extra cost of moving plant over long distances to and from work, and may increase the final cost of the work from $1,000 to $6,000 per appropriation.

This improvement, once thoroughly completed, should remain fairly permanent.

This river is in the collection district of Wilmington, N. C.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	19.81
July 1, 1891, balance unexpended	4,980.19
July 1, 1891, amount covered by uncompleted contracts	3,500.00
July 1, 1891, balance available	1,480.19
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging Lockwood's Folly River, North Carolina, opened at 12 o'clock a. m., December 15, 1890, by Capt. W. H. Bixby, Corps of Engineers.

No.	Name and address of bidder.	Price bid.	Remarks.
		Cents.	
1	Atlas Dredging Company, Wilmington, Del	*20	Bid to be reduced 5 cents per cubic yard in case of award of work on Cape Fear River.
2	Alabama Dredging and Jetty Company, Mobile, Ala	†40	

* Per cubic yard in place. † Per cubic yard in situ.

About $3,500 worth of dredging bid for.

Recommended to be awarded to bidder No. 1, Atlas Dredging Company.

There is available for work of improving Lockwood's Folly River, North Carolina, the sum of $5,000.

COMMERCIAL STATISTICS.

This improvement was not commenced before December 31, 1890. At that time the annual commerce was estimated at about $50,000, being limited to vessels of less than 6 feet draft making weekly trips to Wilmington when tides were of usual height.

Two appropriations of about $20,000 each will open a channel of 6 feet at low water, and will probably rapidly develop $350,000 more commerce, giving easy access to a region of about 120,000 acres of good farming lands capable of a commerce of over $4,000,000 per year.

The present actual annual commerce remains the same as in December, 1887, that is, about $50,000 or about 7,000 tons; the actual improvement of this water way not yet being commenced. The details of this commerce are not in form suitable for tabulation.

L 21.

IMPROVEMENT OF YADKIN RIVER, NORTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description, see pages 6[illegible]-648, Annual Report for 1879, and also pages 948–958 of Annual Report for 1888; and for map of river and of work done and proposed, see page 1164 of Annual Report for 1890.

(2) *Original condition.*—The Yadkin River, North Carolina (the upper end of the Great Pedee River), has a total length of about 215 miles and a drainage area of 4,320 square miles. Its middle third, extending from the railroad bridge near Salisbury 64½ miles upward to the foot of Bean Shoal, is the only portion so far under improvement by the General Government.

When placed under governmental improvement, in 1880, this portion of the Yadkin River had a slope of 2 feet to the mile, had its navigation completely obstructed by rock ledges, fish and mill dams, and numerous shoals, and had as little as 1 foot maximum depth at ordinary low water on some of its shoals and ledges. Its river commerce was nothing.

(3) *Plan of improvement.*—The original project of 1879 proposed to secure a 2.5 to 3 foot steamboat navigation during the entire year over the 64½ miles above the Salisbury Railroad Bridge. The total final cost of the work necessary to secure the desired depth during only mean winter stages of water (two-thirds of the year) was estimated in 1887 at $400,000.

A personal examination of the river over the 33 miles above the Salisbury Railroad Bridge in 1886-'87 showed the agricultural richness of this part of the river basin and its urgent need for transportation facilities, and modified project of 1887 proposed to limit the work to the lower 33 miles of the river, at a total cost of $107,000.

The aggregate amount appropriated for this project up to June 30, 1891, is $102,000.

(5) *Results.*—Up to June 30, 1890, a total of $96,450.48, including outstanding liabilities, has been spent in all upon this improvement in securing a good channel for flatboats (and an indifferent channel for steamboats) of 40 to 70 feet width and from 2 to 2½ feet depth during mean winter stages of water (eight months of the year) from the Salisbury Railroad Bridge 33 miles upward to Baileys Ferry.

No river commerce had yet been created, and none was expected until the improvement was completed in good shape to Baileys Ferry.

The navigation of the river within these 33 miles was not obstructed by bridges without draws.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $2,721.06; value of United States plant, $2,160.

New funds were not available until after the water had risen for the winter. High water then prevented resumption of rock work until May, 1891.

During suspension of work six stone boats, loaded with 10 cubic yards of stone, were sunk for storage in shoal water at Barnes Shoal; the remainder of the United States plant was laid up and watched at Fulton Ferry, 26 miles above the railroad bridge.

During the working season 1 hoister, 4 stone flats, 2 quarter boats, 3 other flats, and other plant were in use.

Owing to its varied character and to the difficulty of estimating it beforehand and measuring it up afterwards, the work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

At Shoal No. 18½ (Peebles's Mill, 26 miles above the Western North Carolina Railroad Bridge) 10 linear feet of dams were removed and 97 linear feet extension of dams were built, completing work of approved project.

At Shoal No. 19½ (Hartley's Mill, 28 miles above the railroad bridge) 40 linear feet extension of dams were built to complete work.

At Shoal No. 21½ (Grimes' Mill, 31 miles above railroad bridge) 20 linear feet of dams were removed so as to complete work.

At Shoal No. 13 (Barnes, 16 miles above railroad bridge) 60 cubic yards of rock were removed.

At Shoal No. 11 (Dutchmans Island, 14 miles above railroad bridge) 150 linear feet of dam were built.

Inspections of plant and work were made during the year.

Water gauges have been kept at two places during the year.

The work of this improvement during the year has been very efficiently carried on under the immediate supervision of Superintenden Frank Brown, whose report is herewith appended.

The work of the past year has finished the removal of the worst ro obstructions and left a fairly well-cleared channel everywhere at lea 60 feet wide and at least 2.5 feet deep at ordinary low water fro Baileys Ferry (33 miles above the railroad bridge, 17 miles down t Barnes Shoal (16 miles above the railroad bridge). The river belo Barnes Shoal still needs much work.

The latest reliable commercial statistics, those for the year endin December 31, 1890, are herewith appended.

(6) *Recommendations for future work.*—It is recommended that th improvement be completed in accordance with the existing projects on so far as to secure a cleared channel way of 60 feet available width an 2.5 to 3 feet clear depth at average winter water (8 months of the yea from the railroad landing close to and just below the Salisbury Railroad Bridge, 33 miles, up to Baileys Ferry, at an expense of $5,000 i addition to the funds on hand on June 30, 1891; this amount to be appropriated at once in a single sum. Smaller appropriations will involv the alternate disorganization and reorganization of working partie damage to unfinished work, deterioration of plant, and extra superintendence and care of property, and may increase the cost from $2,0 to $6,000 per appropriation. Further improvement so as to extend th navigation over the remaining 30 miles is not recommended until th development of a reasonable commerce on the lower 33 miles shall sho the worthiness of further improvement.

This recommended improvement, once thoroughly finished, should b comparatively permanent.

This river is in the fifth collection district of North Carolina.

Money statement.

July 1, 1890, balance unexpended	$722.
Proceeds of sale	200.
Amount appropriated by act approved September 19, 1890	5,000.
	5,922.
June 30, 1891, amount expended during fiscal year	2,462.
July 1, 1891, balance unexpended	3,460.
July 1, 1891, outstanding liabilities	431.7
July 1, 1891, balance available	3,028.
Amount (estimated) required for completion of existing project	5,000
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.0
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. FRANK BROWN, SUPERINTENDENT.

UNITED STATES ENGINEER OFFICE,
Mocksville, N. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report of operations for improving Yadkin River, North Carolina, for the fiscal year ending June 30, 1891.

Owing to the want of funds no work was done from July 1, 1890, up to April 1 1891. On this date, having received from Capt. W. H. Bixby, Corps of Engineer U. S. Army, proper authority for beginning operations, I began by gathering laborers, cleaning up, making necessary repairs to plant. Finding the plant in a very

# PROGRESS MAP for 1891
# YADKIN RIVER, N.C.
FROM 1. JULY 1890 TO 30. JUNE 1891.

JETTIES

SCALE

100 0 200 400 600 800 1000 1200 FEET

Based on surveys made by Chas. Humphreys in 1888 under direction of Captain W. H. Bixby, Corps of Engineers, U. S. A.

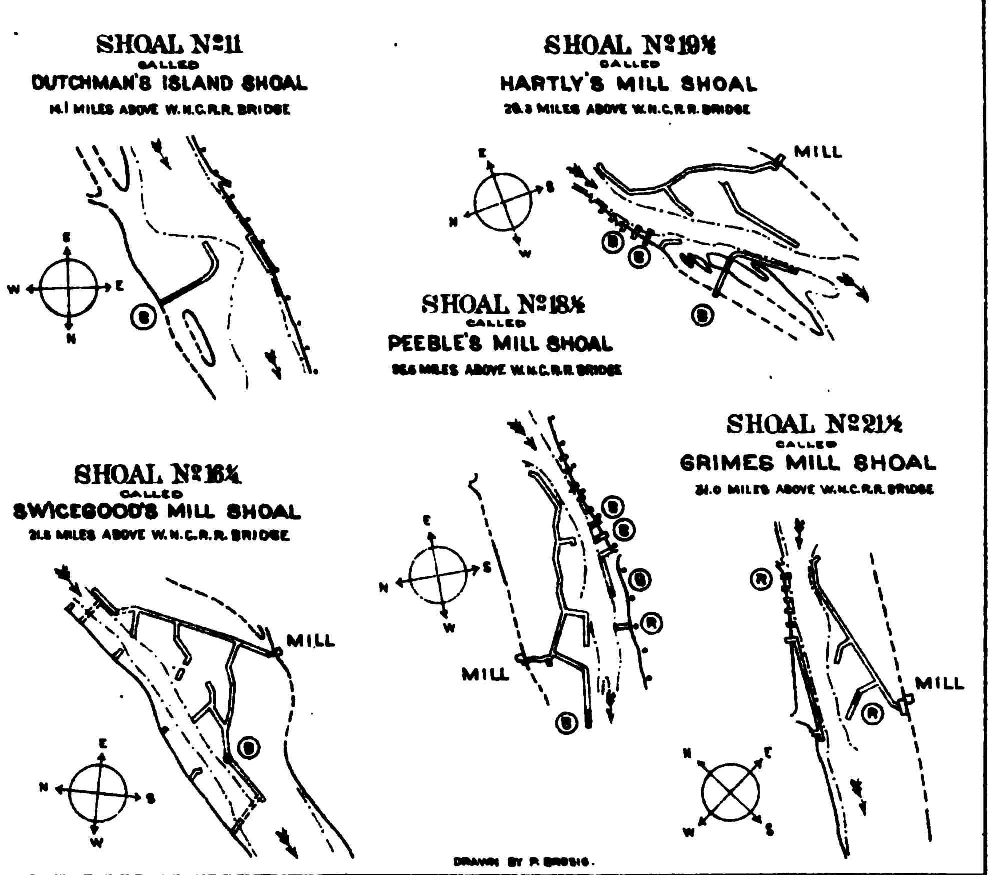
• • • •	SURVEY STAKES	
———	RIVER BANK AT LOW WATER	
—·—·—	3 FT. CONTOUR " " "	
▬▬	JETTIES OR DAMS	
Ⓑ ▬	JETTIES BUILT	DURING FISCAL
▬ Ⓡ	REMOVED	YEAR 1890-91.

Wilmington, N.C. July 1891

Respectfully submitted

W. H. Bixby

CAPTAIN OF ENGINEERS



DRAWN BY P. BROSIG.

much decayed condition, funds on hand limited, and knowing work for the season to be light, I made as little repairs to plant as possible.

On the 28th and 29th of April the entire Government property was inspected by a properly authorized officer.

On May 10 active operations were begun by moving to Peebles's Mills. Since that time work has progressed rather slowly on account of continued flush water. The work of the season will consist in lengthening and cutting off various dams in accordance with maps from Wilmington office and your verbal instructions.

The work of the fiscal year beginning July 1, 1890, and ending June 30, 1891, is as follows:

Care of property from July 1, 1890, to April 1, 1891.

Cubic yards stone quarried and brought from borrow pit	90
Cubic yards of stone sunk in dams	102
Cubic yards of stone raised from dams	24
Linear feet of dams built	197
Linear feet of training walls built	73
Cords of brush collected and sunk in dams	3¼

Very respectfully, your obedient servant,

FRANK BROWN,
Superintendent.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When work commenced in 1880 there was no navigable channel on account of obstructing shoals, rock ledges, and milldams, and consequently there was no commerce.

At present an indifferent channel of from 40 to 70 feet width and 2¼ feet depth during the flush-water season has been secured from the Western North Carolina Railroad Bridge, near Salisbury, up 33 miles. No commerce can be expected until about $10,000 more has been spent on this portion of the river. Then a small boat may be placed on 33 miles of the river.

The river flows through a fertile country mainly without railroad facilities. Were the river open to free and safe navigation all the year, a commerce of from $500,000 to $1,500,000 would soon be developed; but such an improved navigation costing about $600,000 for construction and $25,000 per year for maintenance is not contemplated at present. The restricted flush-water navigation sought by the present project may furnish an annual commerce of $500,000 in a few years after the improvement is finished.

The products of the neighborhood for the year ending December 31, 1890, are estimated roughly as follows:

Articles.		Quantity.	Rate per item.	Value.	Tonnage.
Indian corn	bushels	444,400	$0.75	$333,300	12,000
Wheat	do	130,200	0.90	117,180	3,900
Rye	do	5,000	0.80	4,000	140
Oats	do	43,300	0.40	17,320	700
Tobacco	pounds	304,000	0.13	39,520	150
Cotton	bales	2,500	45.00	112,500	625
Total				623,820	17,515

The above products are being marketed over lines of railroad which are now opening up the fertile valley along the river. Two of these railroad lines were not contemplated when work begun on this river, and it is possible that the work of opening up the river for steamboat navigation was in part the cause of the building of these lines.

The above statistics are based mainly upon the report of Overseer Frank Brown. His report was made from a personal knowledge of the district.

L 22.

IMPROVEMENT OF HARBOR AT GEORGETOWN, SOUTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description of harbor, see pages 1036–1037, Annual Report for 1881; for special history of past work, see page 1029, Annual Report for 1886; for map of harbor, see page 1076, Annual Report for 1887.

(2) *Original condition.*—Georgetown is situated at the head of Winyaw Bay, and at the confluence of the Sampit, Black, Great Peedee, and Waccemaw rivers (these rivers having conjointly a drainage area of 18,040 square miles) and is the natural harbor and seaport for all commerce passing to and from these rivers and their tributaries. Georgetown is also a railroad terminus.

When placed under governmental improvement, in 1880, this harbor had an excellent, well protected anchorage of at least 1 mile in length, 150 feet width, and 15 feet depth. A bar of about 2,850 feet length and with only 9 feet depth of water was the only obstacle to an otherwise good 13-foot navigation from Georgetown 13 miles to the ocean. The commerce of this harbor is estimated to have then been about $4,000,000 of transported goods per year, carried by thirty schooners, seven steamboats, and two steam tugs, measuring in all about 9,000 tons.

(3) *Plan of improvement.*—The original project of 1881, as continued to date, proposed to secure a dredged channel of 200 feet bottom width and 12 feet low water depth entirely through this bar. A personal inspection of this locality and work in 1884 showed the present and future commercial importance of this harbor and the worthiness of the improvement.

The total final cost of this work was estimated in 1889 to be $44,500.

The aggregate amount appropriated upon this project up to June 30, 1891, is $32,500.

(4) *Results.*—Up to June 30, 1890, a total of $23,877.57, including outstanding liabilities, had been expended in all, giving a through cut entirely across the bar, with 12 feet low water depth, and with a variable width of from 80 to 100 feet.

In consequence of the governmental improvements around this harbor the commerce had rapidly increased, being then about $8,000,000 of transported goods per year; showing that each dollar once spent upon this improvement had been accompanied by the development of about $170 of annual commerce.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $58.16; value of United States plant, $260.

Active work was stopped May 22, 1889, for want of funds.

During the past year all work has been confined to office duties and minor work, a small reserve being retained for use in case of emergencies.

Under new appropriations a contract with P. Sanford Ross, of Jersey City, N. J., was approved in January, 1891, dredging to be commenced before August 14, 1891, and to be finished before January 14, 1892.

Inspections of the work were made during the year.

This improvement has been under the efficient supervision of Assistant Engineer Reid Whitford, whose report is herewith appended.

The channel dug in past years is deepening as desired under the tidal scour. The commerce is steadily increasing. Otherwise the general situation is the same as at the commencement of the fiscal year. A single appropriation to complete this work is much needed.

The latest reliable commercial statistics for the year ending December 31, 1890, are herewith appended, showing an annual commerce of $7,994,950 (about 241,648 tons) worth of goods transported per year.

(6) *Recommendations for future work.*—It is recommended: That the above improvement be completed in accordance with the present approved and adopted project, so as to secure a channel of 12 feet depth at mean low water, and of about 200 feet bottom width entirely through the bar; at a total expense of $12,000, in addition to the funds available June 30, 1891; this amount to be appropriated in one sum. Smaller yearly appropriations involving the alternate disorganization and reorganization of working parties, damage to unfinished work, extra superintendence, and deterioration of plant, may increase the cost of the work by about $2,000 per appropriation.

The channel once thoroughly opened will probably be permanent. By this improvement ocean vessels of 12 feet draught, after once crossing the Winyaw Bay Bar, can proceed without further delay 15 miles further to their anchorage at Georgetown.

Georgetown is a port of entry.

Money statement.

July 1, 1890, balance unexpended	$622.43
Amount appropriated by act approved September 19, 1890	8,000.00
	8,622.43
June 30, 1891, amount expended during fiscal year	58.16
July 1, 1891, balance unexpended	8,564.27
July 1, 1891, amount covered by uncompleted contracts	7,000.00
July 1, 1891, balance available	1,564.27
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging harbor at Georgetown, S. C., opened at 11 o'clock a. m., December 16, 1890, by Capt. W. H. Bixby, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard in scows.	Remarks.
		Cents.	
1	P. Sanford Ross, Jersey City, N. J	29	Will commence within 6 months, 2,000 yards weekly.
2	Alabama Dredging and Jetty Company, Mobile, Ala	37	Within 12 months, 1,000 yards weekly.

$6,000 to $7,000 worth of dredging bid for.

Recommended to be awarded to bidder No. 1, P. Sanford Ross.

There is available for work of improving harbor at Georgetown, S. C., the sum of $8,500.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN; I have the honor to make the following report relative to harbor at Georgetown, S. C., for the fiscal year ending June 30, 1891:

The contractor's agent, Mr. C. C. Ely, has sent notice that he will not begin dredging till after July 1, 1891. There has been no work done during the year except the reëstablishment of some survey points, the collection of commercial statistics, and the completion of office records. The channel so far dredged continues to be of much benefit to the shipping.

COMMERCE.

The accompanying commercial statistics have been collected with great care from all sources where freights are received and forwarded. This statement has been revised and corrected by Mr. W. D. Morgan, intendant of Georgetown, and chairman of the commerce committee of Georgetown Board of Trade. Mr. Morgan says he considers it correct.

Two new steamship lines have been started, one from this place to landings on the neighboring rivers; the other by W. P. Clyde & Co. to New York. These, together with all the old lines of both steamers and sail vessels, have run regularly. The mills and factories have all been operated profitably during the year, and generally there seems to be an air of increased prosperity about Georgetown which has not heretofore been noticed.

In the calendar year of 1888 the commerce amounted in the aggregate to approximately 157,521 tons; in 1889 it was about 196,754 tons; in 1890 it was 241,648 tons, showing an increase over 1889 of 44,894 tons.

EMPLOYÉS.

Mr. William Alden James, clerk, has shown his usual zeal, energy, and accuracy in the faithful discharge of his duties, and he has my thanks for the most efficient aid rendered me.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

When the improvement was recommended in 1881 the harbor had an excellent well-protected anchorage of at least 1 mile length, 150 feet width, and 15 feet depth, but with an entrance bar allowing only 9-foot draft boats to pass at low water. The commerce is now estimated to have then been about $4,000,000 per year, carried by 7 steamers, 2 tugs, and 30 ocean schooners and ships. No work on the improvement was commenced until 1884 for want of funds.

At present the improvement is still incomplete. A narrow passage of at least 110 feet width and 12 feet draft has been cut through the bar. The commerce is now estimated at about $7,994,950 per year carried by 11 steamers, 7 tugs, and many ocean schooners and ships, a gain of over $3,000,000 in the past 9 years.

The completion of this improvement will add considerably to the commerce of Georgetown and will lessen rates of insurance and freights. The presence of this inner bar at Georgetown Harbor, taken in connection with the outer bar at Winyaw Bay, has in the past caused a delay of at least two days to vessels entering and leaving Georgetown. The removal of the Georgetown Bar will shorten this delay to one day. In the present partially improved condition of the channel, vessels leaving Georgetown can sometimes by using care save this day now. Georgetown is the natural harbor and seaport of 18,000 square miles of fertile lands belonging to the Sampit, Waccamaw, and Peedee River basins. The development of northern South Carolina requires that Georgetown Harbor be given a deeper channel and better communication to these rivers and to the ocean.

Custom-house statistics.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1889	365	128,705	2,920	2	424	16	1	149	7	368	129,278	2,943
1890	385	165,785	3,150	6	1,346	42	1	106	6	392	167,237	3,198

CLEARED.

Year.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1889	357	126,965	2,856	6	1,494	55	1	149	7	364	128,608	2,908
1890	372	160,458	3,069	9	1,978	63	2	355	18	383	162,791	3,145

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$600,000		$600,000	3,000
Rice	397,500		397,500	4,500
Vegetables and truck	300		300	120
Fish, oysters, etc	100,000		100,000	4,000
Naval stores	1,228,600		1,228,600	41,242
Lumber and products	646,000		646,000	63,700
General merchandise Sundries	1,622,550	$3,400,000	5,022,550	125,086
Total	4,594,950	3,400,000	7,994,950	241,648
Gain over last year			75,250	44,894

Transportation lines established during year, 2, 1 to landings on the neighboring rivers and 1 to New York.

The above statistics are based mainly upon reports of Assistant Engineer Reid Whitford made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Value.	Tonnage.
Commerce at present, as above shown	$7,994,950	241,648
Commerce before the improvement began	4,000,000	*120,800
Development of commerce since beginning of the improvement	3,994,950	120,848
Expended on improvement up to December 31, 1890	23,905	
Development of annual commerce for every dollar spent on the improvement	167	

* Estimated.

L 23.

IMPROVEMENT OF WINYAW BAY, SOUTH CAROLINA.

HISTORY OF PAST OPERATIONS.

(1) *Reference to past reports.*—For special description and maps of bay, see pages 1154–1170, Annual Report for 1885, and page 1114, Annual Report for 1889.

(2) *Original condition.*—Winyaw Bay is the natural and only ocean entrance to Georgetown Harbor and to the Sampit, Black, Great Pe-

dee, Waccamaw rivers and their tributaries, with their 500 miles ot navigable river, 18,000 square miles of drainage area, and their large combined annual commerce.

When placed under governmental improvement in 1886 this bay possessed only 9 feet depth at low water and 12 feet at high water on its bar entrance, and 12 feet depth from the bar for 12 miles up to Georgetown. The commerce of the bay is estimated to have then been about $5,500,000 of transported goods per year.

(3) *Plan of improvement.*—The original estimates of 1885, as continued to date, proposed to secure a permanent bar entrance of 12 to 20 feet depth at low water. When the existing Santee (Mosquito Creek), Congaree, and Wateree river improvements are completed Winyaw Bay will become the entrance to the river basins of one-sixth of North Carolina and one-third of South Carolina, with about 900 miles of navigable river, 34,000 square miles of drainage area, and $12,000,000 of annual commerce. The volume of water moving through the throat of this bay at mid ebb daily, at an average velocity of 2.1 feet per second, is sufficient to actually maintain at this point a channel of 4,000 feet width and 21 feet average depth, so that by the proper expenditure of money there should be no difficulty in obtaining a good bar entrance with 15 to 20 feet depth at low water.

The total final cost of this work was estimated in 1885 to be $2,500,000 for a bar depth of from 15 to 20 feet, the funds to be voted in amounts of about $300,000 per year, the first $800,000 being estimated to give 12 feet depth.

The aggregate amount appropriated for this project up to June 30, 1891, is $218,750.

(4) *Results.*—Up to June 30, 1890, a total of $20,027.45, including outstanding liabilities, had been spent in all upon this improvement in making necessary preparations for beginning work.

The commerce was then about $8,000,000 of exports and imports per year, the development of the last few years having been due to the governmental improvement of the tributary rivers.

PRESENT OPERATIONS.

(5) *Work of the past year.*—The special work of the past year is as follows: Expenditures, including outstanding liabilities, $12,809.43; value of United States plant, $1,100.

One steam-launch and other United States plant was in use during the year.

Owing to the difficulty of properly specifying it beforehand and measuring it afterwards all minor work was, for advantage and economy, allowably done by hired labor and the purchase of materials in open market.

At the beginning of the fiscal year work was in progress under contract with J. S. Howell, of New York City, for $80,000 of jetty work, to be completed by October 1, 1890. At the expiration of the contract time only about one-tenth of the work had been done; the hardest portion had not even been commenced, and it was evident that the contractor could not be depended upon to continue the work satisfactorily. His contract was therefore annulled and new bids were solicited to cover work under the old as well as newer appropriations. New contracts with W. T. Gaynor, of Fayetteville, N. Y., for $180,000 of jetty work were approved in January, 1891, work to be completed before September 18, 1892.

Under Mr. Howell's contract, in July, August, and September, 1890, 307 cubic yards of shell, 445 tons of small stone, and 57 tons of large stone were put in place shoreward of the low-water line.

Under Mr. Gaynor's contract, in March to June, 1891, substantial preparations for active work were made, and 1,013 square yards of mattress, 153 cubic yards of shell, 1,880.02 tons of small stone, and 628.10 tons of large stone have been put in place, mainly shoreward of low-water line.

Deeds to the right of way for the jetties were approved by the Attorney-General in October, 1890.

Water-gauge records have been kept during the year.

The work of the United States on this improvement has been very efficiently carried on under the immediate supervision of Assistant Engineer Reid Whitford until the 25th May, 1891, when it was transferred to Assistant Engineer Charles Humphreys. Their reports are herewith appended.

The work of the past year has not progressed sufficiently far to effect any improvement in the navigation facilities. There is only about 7 feet at low water on the ocean bar, and vessels are frequently subjected to considerable delay.

The latest reliable commercial statistics, those for the year ending December 31, 1890, are herewith appended, showing a commerce of $8,505,625 per year, about 261,029 tons.

(6) *Recommendations for future work.*—It is recommended that this improvement be carried on in accord with the existing projects by the construction of stone dikes across the sloughs and along the inner edges of the breaker shoals until a good channel of from 12 to 20 feet depth at low water is obtained at one or both bar entrances, at a total cost of $2,500,000 for a 20-foot depth ($2,281,250 in addition to the funds available June 30, 1891), this amount to be appropriated in annual installments of as much as $300,000 each.

Smaller yearly appropriations will involve the alternate disorganization and reorganization of working parties, damage to unfinished work, deterioration of plant, extra superintendence, care of plant, etc., and may increase the final cost by from $2,000 to $20,000 per appropriation.

Various personal examinations of the locality and its surroundings have shown worthiness of this improvement (that of the outlet to the river basins of two-thirds of South Carolina) and the urgent need for large appropriations and rapid work. The first $800,000 of work will probably increase the depth on the bar to 12 feet at low water, a depth sufficient to very greatly increase and benefit the commerce of the neighboring Waccamaw, Pedee, Black, and Sampit rivers and Georgetown Harbor.

The improvement once thoroughly finished should remain comparatively permanent.

Money statement.

July 1, 1890, balance unexpended		$100,320.57
Amount appropriated by act approved September 19, 1890		100,000.00
		200,320.57
June 30, 1891, amount expended during fiscal year		8,561.76
July 1, 1891, balance unexpended		191,758.81
July 1, 1891, outstanding liabilities	$5,845.69	
July 1, 1891, amount covered by uncompleted contracts	172,041.79	
		177,887.48
July 1, 1891, balance available		13,871.33

Amount (estimated) required for completion of existing project	$2,281,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for sheet piling, stone, mattresses, etc., Winyaw Bay, South Carolina, opened at 12 o'clock m. on the 15th day of December, 1890, by Capt. W. H. Bixby, Corps of Engineers.

	No. 1. David V. Howell.		No. 2. Skinner & Wallace, Wilmington, N. C.		No. 3. W. T. Gaynor, Fayetteville, N. Y.		No. 4. Roderic G. Ross, Jacksonville, Fla.	
	Bids.	Amount.	Bids.	Amount.	Bids.	Amount.	Bids.	Amount.
100,000 feet, B. M., sheet piling on shore, etc	$93.00	$9,300	$40.00	$4,000	$45.00	$4,500	$50.00	$5,000
900,000 feet, B. M., sheet piling seaward, etc	147.00	132,300	60.00	54,000	53.00	47,700	60.00	54,000
300 cubic yards oyster shell on shore, etc	1.30	390	1.40	420	1.30	390	1.50	450
3,000 cubic yards oyster shell seaward, etc	1.18	3,540	1.25	3,750	1,30	3,900	1.55	4,650
1,000 tons small stone on shore, etc	2.61	2,610	2.85	2,850	2.75	2,750	2.75	2,750
30,000 tons small stone seaward, etc	2.47	74,100	2.63	78,900	2.50	75,000	2.65	79,500
2,000 tons large stone on shore, etc	3.07	6,140	3.25	6,500	3.00	6,000	3.50	7,000
6,000 tons large stones seaward, etc	2.87	17,220	3.25	19,500	2.90	17,400	3.50	21,000
50,000 square yards mattresses in work, etc	.82½	41,250	.80	40,000	.70	35,000	.90	45,000
Total	....	286,850	....	209,920	....	192,640	....	219,350
Will commence within	10 days		60 days		60 days		60 days	
Monthly progress	$10,000 per month		$10,000 per month		$10,000 per month		$10,000 per month	

Recommended that award be made to bidder No. 3, W. T. Gaynor.

There is available for work of improving Winyaw Bay, South Carolina, the sum of $194,000.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations upon Winyaw Bay, under J. S. Howell, contractor, during the fiscal year ending with this date:

STATEMENT OF WORK DONE.

Small and large stone ballast, 502.197 tons, of 2,000 pounds, put in place, of which 292.877 tons went on the east wing, 209.32 tons went on the main dike. Oyster shell, 307.45 cubic yards put in place, of which 136.58 was deposited on the east wing, 119.33 cubic yards on the main dike, and 51.54 cubic yards on the west wing.

Because of Mr. Howell's failure to comply with the terms of his contract he was ordered to attempt no more work after September 30, 1890.

The next contract was awarded to W. T. Gaynor. He purchased from Mr. Howell what plant he had on hand here.

COMMERCIAL STATISTICS.

A full report of same forwarded to your office some time ago.

EMPLOYÉS.

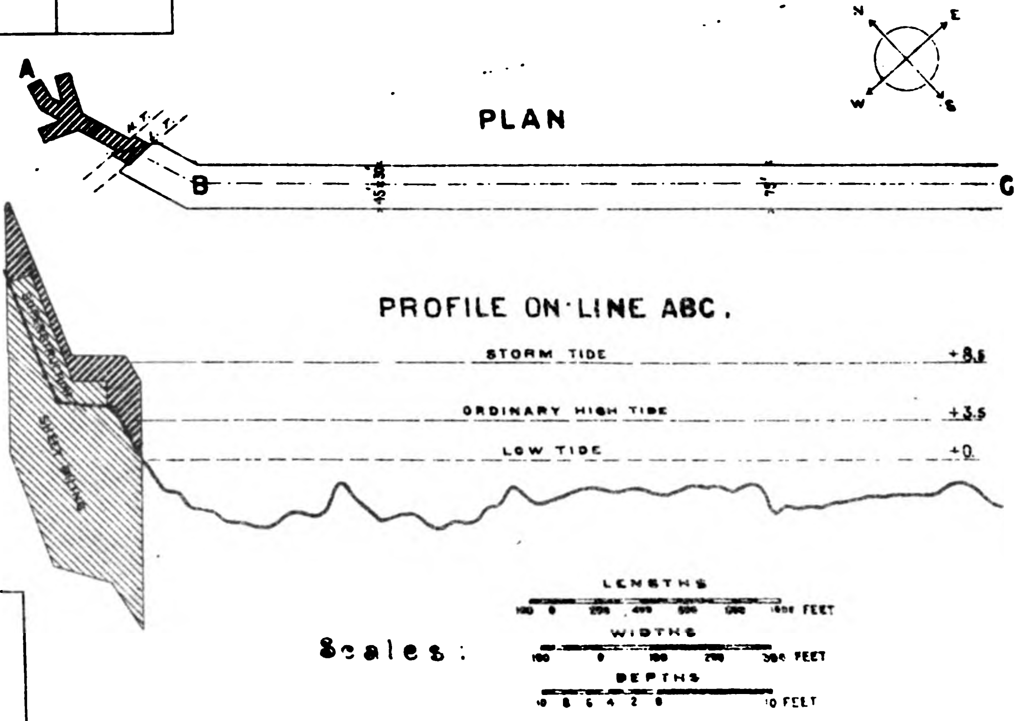
To comply with your orders this work was turned over to Mr. Charles Humphreys, assistant engineer, May 25, 1891.

PROGRESS MAP FOR 1891
WINYAW BAY, S.C.
FROM 1. JULY 1890 TO 30. JUNE 1891.

SHEET
Nº 3.

NORTH ISLAND MAIN JETTY

Based on surveys made by R Whitford in 1889
under direction of
Captain W. H. Bixby, Corps of Engineers, USA.



▧ WORK OF PREVIOUS YEAR
▨ WORK OF FISCAL YEAR 1890-91.

Wilmington, N.C. *July 1891.*
Respectfully submitted
W. H. Bixby
CAPTAIN OF ENGINEERS

DRAWN BY P BROSIG

I am indebted to Mr. William T. McNelty, inspector, and Mr. S. F. Burbank, subinspector, for efficient and valuable aid while in local charge of this work.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
North Island, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations upon Winyaw Bay, South Carolina, for the fiscal year ending with this date:

STATEMENT OF WORK DONE.

Surveys.—Contour surveys and maps were made during October last on North Island from the light-house southwardly, including all the land to the low-water line; on South Island, that portion of the shore in the vicinity of the proposed head of the south jetty. These maps have already been forwarded to your office.

A tide gauge was kept during the year at North Island.

HIRED-LABOR WORK.

Tide-gauge station was constructed at North Island, consisting of piles driven firmly in the sand bottom of the bay, upon the top of which rests a platform and small gauge house.

Minor repairs were made to lifeboat, float tubes, and displacement measurement gauges.

CONTRACT WORK.

Mr. W. T. Gaynor, contractor, began active operations May 6 on the north jetty. The following work has been completed to date:

STONE WORK.

1880.02 tons (of 2,000 pounds) of small stone ballast have been placed shoreward as follows: 48.73 tons on east wing, 283.50 tons on west wing, 1,592.79 tons on main jetty.

628.10 tons large stone have been placed shoreward as follows: 278.22 tons on east wing and 349.88 tons on main dike.

MATTRESS WORK.

1,013 square yards placed on main jetty from low-water line shoreward.

OYSTER SHELLS.

153 cubic yards placed on main jetty from low-water line shoreward.

GENERAL REMARKS.

Previous to the commencement of active operations on May 6 the contractor constructed a substantial wharf and a railroad track on trestle work extending from head of wharf to main jetty; thence along the line of the jetty to the low-water line. This track is used in carrying stone and other material in dump cars of 2 tons capacity, drawn by an 8-ton locomotive.

A set of improved Fairbank's scales was placed conveniently in the track for the purpose of weighing stone as it passes to its place in the jetty. The contractor also constructed pile drivers on large platform cars for the purpose of putting down sheet piling and extending the trestle work seaward as the work of building the jetty progresses.

All work completed has been well and substantially executed by the contractor.

The depth on the outer bar still remains shallow, there being about 7 feet at low tide and about 11½ feet at high tide. This, of course, is greatly detrimental to the commerce of Georgetown and its neighboring rivers and towns.

EMPLOYÉS.

This work was in local charge of Reid Whitford, assistant engineer, till May 25, when it was transferred to the undersigned.

Much credit is due Mr. P. E. Twiggs, inspector, for faithful and efficient service, and he has my thanks for valuable aid in my efforts to carry out your orders. Mr. S. F. Burbank, subinspector, who made the surveys last fall, did his work faithfully and correctly, as I have been informed by Mr. Whitford.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

This bay is the ocean entrance to Georgetown Harbor, South Carolina.

The present commerce of this bay is that of the Waccamaw, Peedee, Black, and Sampit Rivers, and Georgetown Harbor, a commerce carried by many ocean vessels and two steamers making weekly trips to New York and Charleston. At the ocean bar there is at present only 7 feet depth at ordinary low water; otherwise navigation is practicable for boats of 12 feet draft. At present, however, vessels drawing no more than 10 to 12 feet are frequently detained for several days, and sometimes weeks, awaiting a flush high water to take them over the bar; and however great the distress in which a vessel may be while approaching the harbor, no tug drawing over 6 to 7 feet can go to her assistance during low water.

Already Winyaw Bay is the outlet to about $8,500,000 of annual commerce of the Sampit, Black, Peedee, and Waccamaw rivers. More than this, it is now connected by a 7-mile canal to the Santee River, so that it will soon be the shortest and most accessible outlet to $5,000,000 of annual commerce, which will come down the Congaree, Wateree, and Santee rivers as soon as the railroad bridges over these rivers are properly furnished with draw spans. These river basins at present raise over 400,000 bales ($16,000,000) of cotton per year (see 1880 Census Reports). These rivers are now navigable over 800 miles by steamers and over 1,000 miles by pole boats. The amount of water now flowing in and out of Winyaw Bay at mid-tide is about 220,000 cubic feet per minute; sufficient to keep open passage of 4,000 feet width and 21 feet average depth if provided with proper training walls or dikes. All opinions of the Government engineers in charge of this improvement so far have been to the effect that the bar is well worthy of improvement, and that it can be easily improved provided the necessary funds are voted in adequately large annual appropriations.

Three appropriations of $300,000 each properly spent would undoubtedly develop at once an additional commerce of from $8,000,000 to $9,000,000 per year.

The commerce for the year ending December 31, 1890, is estimated as follows:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Cotton and products	$750.000		$750,000	3,750
Rice	400,500		400,500	4,610
Vegetables and truck	750		750	30
Live stock and products	875		875	6
Fish, oysters, etc	112,500		112,500	4,500
Naval stores	1,229,000		1,229,000	41,262
Lumber and products	771,000		771,000	76,616
General merchandise Sundries	1,841,000	$3,400,000	5,241,000	130,255
Total	5,105,625	3,400,000	8,505,625	261,029
Gain over last year			585,952	64,275

Transportation lines established during the year, 2; 1 trading with neighboring rivers and 1 to New York.

The above statistics are based mainly upon reports of Assistant Engineer Reid Whitford, made after much correspondence and conversation with steamboat captains and agents, custom-house officials, and prominent shippers and merchants.

	Value.	Tonnage.
Commerce at present, as above shown	$8,505,625	261,029
Commecre before improvement began	4,000,000	125,000
Development of commerce since beginning of improvement	4,505,625	136,029
Expended on improvement up to December 31, 1890	24,056	
Development of annual commerce for every dollar spent on the improvement.	187	

L 24.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

Schooner opposite Swan Point, Pamlico River.—In February, 1891, the people navigating Pamlico River made complaint that the old wreck of an old schooner had drifted into a position near the main channel of the Pamlico River below Washington, N. C., in such way as to endanger the navigation of that river.

Examination elicited the following information:

This schooner was a two-masted wooden vessel of about 90 feet length, 25 feet beam, 7 feet draft, and 90 tons burden, and was sunk about 1882 by running upon other wrecks then in the river. Immediately after sinking it was stripped of everything then deemed worth saving and was then abandoned. Since then it is reported to have several times shifted its position under the effect of storm, tides, and currents, and also to have been set on fire 3 years ago, burning to the water's edge.

Portions of the wreck rose to 1 foot above low water and other portions descended to 10 feet below low water.

The natural bottom was sand and mud, with accumulations of sand around the wreck to 3 to 5 feet depth on the bow and nothing at its stern.

There was supposed to be nothing about the wreck of any special value or specially worth saving.

By virtue of the provisions of the law of the 14th of June, 1880, and of section 8 of the river and harbor act of 19th of September, 1890, authority was granted in March, 1891, for the removal of this wreck, and $150 was allotted for that purpose.

Owing to its character and its small cost, the removal of this wreck was allowably to be done by hired labor and the purchase of materials in open market, using the employés and plant belonging to the improvements of this and neighboring streams.

No work was done prior to the 30th of June, 1891, as it was thought best to wait until the Government plant should next pass that way.

L 25.

PRELIMINARY EXAMINATION OF WATER-WAY FROM PUNGO RIVER TO THE TOWN OF SLADESVILLE, NORTH CAROLINA.

[Printed in House Ex. Doc. No. 160, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 7, 1891.

SIR: I have the honor to submit the accompanying copy of report, dated December, 1890, by Capt. William H. Bixby, Corps of Engineers, giving results of preliminary examination of water way from Pungo River to the town of Sladesville, N. C., made to comply with provisions of the river and harbor act of September 19, 1890.

It is the opinion of Captain Bixby and of Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, that this locality is not worthy of improvement by the United States. I concur in this opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF CAPTAIN W. H. BIXBY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 27, 1890.

GENERAL: In accordance with the river and harbor act of 19th of September, 1890, and letters and orders from your office dated September 20 and October 4, 1890, I have the honor to submit herewith the following report upon a preliminary examination of the water way from Pungo River to the town of Sladesville, N. C.

This examination was made by Lieut. M. M. Patrick, U. S. Engineers, under my orders. His full report is appended. My opinions, as below stated, are based partly on his report and partly upon my own personal knowledge of the character of North Carolina sounds and creeks of this part of the State.

Sladesville is a small town near the head of Slade Creek, which latter is an arm of Pungo River, the latter in its turn being an arm of Pamlico Sound. Sladesville has a commerce of about $130,000 per year, and is the shipping and receiving point for the neighboring country within a 10-mile radius. This commerce is shipped away from Sladesville by boats of less than 5-foot draft. Either sail or steamboats of this draft can go with safety and ease from Slade Creek, opposite Sladesville, via creek, river, sounds, and canals, to Norfolk, or, via the creek and Pungo River, to the wharves of the Albemarle and Pantego Railroad, which has through connection with Norfolk. It is claimed that with better shipping facilities the commerce of this region might be increased by 50 per cent., or by about $60,000.

Sladesville (probably for residential and sanitary reasons) is not situated on Slade Creek itself, but on the northern of the two branches which unite to form this creek.

Slade Creek itself has a width of about 400 feet and a channel depth of about 5.5 feet at the mouth of the Sladesville branch, these dimensions increasing gradually up to a width of 1 mile and a channel depth of 9 feet at the point where it joins Pungo River. These dimensions of the creek itself are already equal to the needs of existing commerce and that of several years to come.

The branch, from Sladesville to Slade Creek, is about 35 feet wide and 4.5 feet deep, with marsh banks about 2 feet above ordinary water level. There is little or no current or tides in these branches, creeks, or rivers, except as caused by winds.

This Sladesville branch acts as a canal, connecting Sladesville with Slade Creek. At its junction with Slade Creek there is a short mud bar on which the water is only 2.5 feet deep. The removal of this bar, the straightening of the branch at a few bad turns, and the removal of a few logs in the branch, is all that is necessary to complete a water way from Pungo River to Sladesville suitable for its existing and prospective commerce. This is estimated to cost only about $2,300. However, there appears to be several places on Slade Creek opposite Sladesville which are not only suitable for wharfage purposes, but which could be readily utilized as such at a cost of merely building a half mile or so of ordinary roadway. Since all produce brought to Sladesville for shipment has to be hauled several miles in carts, it might be taken direct to deep water on the creek without any extra cost for haulage if such wharves and roadway were in existence.

In short, the dredging out of the branch from Slade Creek to Sladesville (which is all that needs to be done) appears to be a question of purely local benefit, and one whose natural solution would be that the town, county, or interested shippers, or steamboat lines, should either dredge a short canal from the creek to their wharves and wharehouses, or should move their wharves and warehouses down to the side of the creek and build a short roadway to them.

For these reasons I am of the opinion that the water way from Pungo River to the town of Sladesville, N. C., is not at present worthy of improvement by the United States.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 3, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December, 1890, by the local engineer, I am of the opinion that the water way from Pungo River to the town of Sladesville, N. C., is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF LIEUTENANT MASON M. PATRICK, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 15, 1890.

CAPTAIN: I have the honor to submit the following report upon the preliminary examination of the water way from Pungo River to the town of Sladesville, N. C., with a view to its improvement by the General Government, made in compliance with your orders to me dated November 11, 1890.

Information as to this water way was asked through newspapers and through circular letters sent to the postmaster at Sladesville, to the county commissioners of Hyde County, and to other parties supposed to be interested in the possible improvement. In answer to these letters and inquiries only very few replies have been received.

The information embodied in the following report was obtained mainly by conversation with residents of Sladesville and the surrounding country and by my own personal inspection of the locality.

For map of the water courses described, and the localities mentioned in the following report, see Coast Survey charts Nos. 143, 144(1), and plate No. 1839, Atlantic Coast Pilot, subdivision No. 19.

Pungo River, like Pamlico River, with which it unites, is in fact an arm of Pamlico Sound, and it extends some distance into the interior. At its junction with the Pamlico River it has a width of about 3 to 3½ miles; its channel is wide and unobstructed, and with a minimum channel depth of 16 feet at mean low water.

About 6 miles above the mouth of the Pungo River Slade Creek enters it from the east. The river at this point is about 3 miles wide, channel broad, channel depth about 14 feet. Slade Creek, at its junction with the Pungo, has a width of about 1 mile and a straight channel with a depth of 9 feet at mean low water. There is but little regular ebb and flow of tides in either the creek or the river, the differences in water level being caused mainly by the winds. In general an easterly wind causes a rise and a westerly wind a depression of the water surface. At the date of my examination (November 21, 1890) the water surface was about the level of mean low water, and consequently the conditions were favorable for the examination. Above its junction with the Pungo River Slade Creek extends into the interior for some distance, gradually diminishing in width until at a point about 5 miles from its mouth it is only about 400 feet wide. Up to this point the channel is broad and unobstructed, with a minimum depth of 5.5 feet, the bottom being sand overlaid with soft mud. At this point, about 5 miles from its mouth, the creek divides into two branches, each of which extends into the interior for about 2½ to 3 miles, and then loses itself in the swamp.

On the northern branch, about 1,600 to 2,000 feet above its mouth, is situated the small town of Sladesville. Here the creek is about 30 to 35 feet wide and about 4.5 feet deep. The banks are marsh; the general level of the marsh being about 1½ to 2 feet above mean low-water level.

Sladesville derives its importance from the fact that it is the shipping and receiving point for the country around within a radius of about 10 miles. At present produce is shipped from this point, and goods from the outside are brought in by small sailing vessels of about 12 to 15 tons burden, drawing about 3 to 4 feet of water when loaded. Three such boats endeavor to run regularly, and at present average about one trip a week; three or four other boats make trips irregularly. The country around Sladesville is eminently adapted for agriculture and good crops are raised. This region is much in need of increased transportation facilities in order to fully develop the capabilities of the country.

The present commerce is estimated as follows: Within a radius of 5 miles from Sladesville there are eleven stores, each doing an average business of about $3,000 per year, or a total of $33,000; but the country for at least 10 miles from Sladesville draws its supplies from this point, and increasing our radius 5 miles will add at least two-thirds to the above total of $33,000. In addition to this, I am informed that a number of the larger farmers in this section order their supplies directly to the amount of at least $5,000 per year; this would make the imports $60,000.

The exports are as follows:

Cotton, 1,200 bales	$54,000
Rice, 5,000 bushels, at 80 cents	4,000
Truck	3,000
Corn	3,000
Lumber	5,000
Total	69,000

Total exports and imports, $129,000.

Freight charges are high, and on account of the frequent delays at present the trucking industry has been but little developed.

It is estimated that additional shipping facilities and quick and regular trips would increase the present commerce by at least 50 per cent., or an annual increase of $64,500.

From my description of the main creek it will be seen that up to where it divides into the two branches there is nothing to obstruct the navigation by boats drawing less than 5.5 feet.

At the mouth of the branch upon which Sladesville is situated there is a bar on which the average depth is only about 2.5 feet. This bar is about 150 feet wide and extends entirely across the mouth of the creek; it is composed entirely of soft mud, into which an ordinary sounding rod will easily penetrate for about 4 feet. This bar interferes at present with the small sailboats which run up to Sladesville; they have to push and pole across it.

After crossing this bar there is no difficulty in carrying 4.5 feet up to Sladesville. The only obstructions to navigation between the town and the bar at the mouth of the creek consist of a few logs lying on the bottom of the creek, but which can be easily removed. It is also possible that one or two projecting points would have to be taken off, thus widening and straightening the approach to the dock at Sladesville.

So far as can be learned there has been no material change in the condition of the bar at the mouth of the creek for many years.

The following is an estimate of the cost of the improvement to permit the carrying of 4.5 feet at mean low water to Sladesville:

Removing bar at mouth of creek:

Dredging 3,300 cubic yards mud, at 30 cents	$990.00
Dredging to widen and straighten approach to Sladesville docks, 2,720 cubic yards, at 30 cents	816.00
Removing logs from creek	100.00
	1,906.00
Contingencies, 20 per cent	381.20
Total	2,287.20

The above estimates of the amounts of material to be removed are based upon data obtained during my preliminary examination, and are believed to be approximately correct. The estimates of cost are based upon past work in this district. It must be stated, however, that it did not seem improbable that a road could be constructed from Sladesville across the marsh to the mouth of the creek, a distance of not over 2,000 or 2,500 feet, and a wharf constructed at this point where a steamer or other boat could readily come and where goods and produce could be easily loaded and unloaded.

Should the above improvement be decided upon, a short survey might be necessary to accurately fix the limits of the needed dredging. Such a survey should not cost over $200.

The total cost of the preliminary examination upon which the above report is based was approximately $42.

Very respectfully, your obedient servant,

MASON M. PATRICK,
First Lieutenant of Engineers.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

L 26.

PRELIMINARY EXAMINATION OF WATER-WAY BETWEEN PAMLICO RIVER AND BAY RIVER, NORTH CAROLINA.

[Printed in House Ex. Doc. No. 162, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 7, 1891.

SIR: I have the honor to submit the accompanying copy of report, dated December 27, 1890, by Capt. William H. Bixby, Corps of Engineers, giving results of a preliminary examination of water-way between Pamlico River and Bay River, North Carolina, made in compliance with requirements of the river and harbor act approved September 19, 1890.

Captain Bixby states that there are three routes at present used in going from Pamlico River to Bay River; that the existing longest route is already deep, wide, and free of obstructions, while the shorter routes and the proposed new inland route are either impracticable or too costly in proportion to the resulting gain to commerce. He is therefore of the opinion that the locality is not at present worthy of improvement by the United States.

This opinion is concurred in by the Division Engineer, Col. William P. Craighill, Corps of Engineers, and by this office.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF CAPTAIN W. H. BIXBY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 27, 1890.

GENERAL: In accordance with the river and harbor act of September 19, 1890, and letters and orders from your office dated September 20 and October 4, 1890, I have the honor to submit herewith the following report upon a preliminary examination of the water way between Pamlico River and Bay River, North Carolina.

This examination was made by Lieut. M. M. Patrick, U. S. Engineers, under my orders. His full report is appended. My opinions, as below stated, are based partly on his report and partly upon my own personal knowledge of the character of North Carolina sounds and creeks of this part of the State.

There are three routes at present used in going from Pamlico River to Bay River. Both rivers are arms of Pamlico Sound, and their mouths are about 10 miles apart; but their deep-water channels into Pamlico Sound are separated by a long shoal called Brant Island Shoal, whose end is marked by the Brant Island light. In fine weather, light (2 feet) draft boats, going from one river to the other, can go direct from mouth to mouth following the general shore line, and medium (5 feet) draft vessels can cross the shoal at points not over 6 miles from shore; but deeper draft vessels at all times, and medium draft vessels in rough weather, must go around Brant Island light, 10 miles from shore. As Pamlico Sound is sometimes exceedingly rough in bad weather, all vessels naturally desire an inner route if it be possible. Such a route might be obtained by leaving Pamlico River a few miles above its mouth, going up Goose Creek about 6 miles, and through a canal of about 1.5 miles length to be cut across marsh, woods, and cleared land, thus reaching deep water in Jones Bay, whose mouth joins that of Bay River. This 1.5 miles of canal would allow medium (5 feet) draft vessels to entirely avoid all but a mile or two of Pamlico Sound, shortening their route from 1 to 3 miles in fine weather and from 10 to 15 miles in rough weather. This route would be of great convenience to the many lumber tows and oyster boats which now have to go by the longer and more exposed route. The cost of this canal route is estimated at, at least,

$41,000. The remaining mile or two of Pamlico Sound could if necessary be avoided in like manner by another similar canal cutting from Jones Bay direct into Bay River at a cost of perhaps from $20,000 to $40,000 more.

The present commerce passing between Pamlico and Bay rivers is estimated at about $335,000. While the canal from Goose Creek to Jones Bay would be a great convenience, it does not appear that the commerce would be thereby especially increased nor the freight charges especially decreased. Under these circumstances it does not appear that the canal route is a necessity, nor that the resulting benefits would be proportionate to its cost.

It is possible that a route could be chosen over Brant Shoal within a few miles of shore, where a 6 or 7 foot depth channel could be cut through at moderate cost. But the bottom of the sound in the neighborhood of this shoal is almost entirely loose sand, and a channel once dredged would probably require constant redredging or costly diking to keep it permanently open, so that its expense would probably finally equal if not exceed that of the canal route.

In short, the existing longest route between the two rivers is already deep, wide, and free of obstructions; while the shorter existing routes and any new inland route are either impracticable or too costly in proportion to the resulting gain to commerce.

For these reasons, I am of the opinion that the water way between Pamlico River and Bay River, North Carolina, is not at present worthy of improvement by the United States.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md, January 3, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 27, 1890, by the local engineer, I am of the opinion that the water way between Pamlico River and Bay River, North Carolina, is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF LIEUT. M. M. PATRICK, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 16, 1890.

CAPTAIN: I have the honor to submit the following report upon the preliminary examination of the water way between Pamlico River and Bay River, North Carolina, with a view to its improvement by the General Government, made in compliance with your orders to me dated November 11, 1890.

Information as to this water way was asked through newspapers and through circular letters sent to many parties supposed to be interested in its possible improvement. To these inquiries but very few replies have been received.

The information embodied in the following report was obtained mainly from conversation with residents of the immediate neighborhood, from Mr. S. F. Burbank, who had made a survey of this route at the instance of private parties, and from my own personal inspection of the locality. For maps of the water courses and localities mentioned in the following report, see Coast Survey Chart No. 144' and plate No. 1839, Atlantic Coast Pilot, subdivision No. 19.

From information obtained prior to the time of making this examination it was ascertained that the route contemplated by those who were interested in the examination of this water way was up Goose Creek, across the neck of land separating the head of Goose Creek from Jones Bay, thence down this bay and up Bay River.

Between the entrance to Jones Bay and the mouth of the Pamlico River, Brant Island Shoal extends far out into Pamlico Sound, and vessels plying between the Pamlico River, Jones Bay, and Bay River are compelled to go some distance out into Pamlico Sound in order to round or cross this shoal. A short distance above the mouth of the Pamlico River Goose Creek enters it from the south. This creek is about 1 mile wide at its mouth; the channel at the entrance is narrow and crooked, but has a least depth of 10 feet at mean low water. At the time of my examination (22d of November, 1890) the water surface in this creek was at about the level of mean low water. Above its mouth this creek extends some distance into the interior. Three miles above the mouth, Eastham Creek enters it from the east; about 4 miles above its mouth the creek separates into two branches, one known as Campbell Creek, the other as Upper Spring Creek. Up to this point of diversion the channel of Goose Creek is straight, broad, and unobstructed, with a minimum depth of 9 feet and an average depth of about 11 feet. Upper Spring Creek extends for about 1¼ miles farther with good width and a channel depth of at least 7 feet. At a point about 1¼ miles from its mouth this creek divides into two branches, the southern one of which was followed for a distance of about 1 mile. At the entrance to this branch there is a bar of soft mud with a depth of water of only 4 feet; after crossing this bar the depth was never less than 5.5 feet until the creek became so narrow and winding that it could be followed no longer in the boat.

On both sides the banks were marshy, the marsh averaging about half a mile in width and the level of the marsh being about 1.5 feet to 2 feet above mean low-water level. Leaving the boat we walked across to the shore of Jones Bay, and, returning to the boat, distances were estimated by pacing and directions taken by means of a pocket compass, the features of the country being noted as carefully as possible. This examination indicates that to connect Goose Creek with a point in Jones Bay, where 6 feet of water can be carried, would require a cut of about one mile and a half in length; about one-half of this distance would be across a swamp, one-fourth through woods, and the remaining fourth across cleared land. The average height of this land above mean low water is about 2.5 feet.

The following is an estimate of the expense of making a cut as above described, 40 feet wide and 6 feet deep at mean low water; excavation, cut 2,640 yards long, 40 feet wide; depth of cutting, 9 feet:

105,600 cubic yards mud and sand, at 30 cents per cubic yard	$31,680
Removing trees, stumps, etc	2,500
	34,180
20 per cent. for contingencies	6,836
Total	41,016

Should the above described cut be made it is possible that a similar cut could be made from near the head of Jones Bay, connecting directly with Bay River, thus enabling shipping between Pamlico River and Bay River to avoid Pamlico Sound entirely.

The above estimates of the amount of material to be removed are based upon data obtained during my preliminary examination, and are believed to be approximately correct. The estimate of cost is based upon past work in this district.

At present the commerce between Pamlico River and Bay River is carried on by one steamer drawing about 4.5 feet of water, run in connection with the Albemarle and Pantego Railroad, produce being shipped over this road to Norfolk, Va. This steamer, at present, in the run from Pamlico to Bay River, is compelled to go out into Pamlico Sound and across Brant Island Shoal. Should the above described cut be made, her route would be shortened by about 1 to 3¼ miles in ordinary weather, and from 10 to 15 miles in rough weather, and this new route would be less exposed than the one at present followed. In addition to the above there are other points to be taken into consideration when examining the importance of the proposed route. There is a sawmill (Young's), situated on Jones Bay, which cuts about 5,000,000 feet of lumber per year. A considerable proportion of this lumber is brought down the Pamlico River and is towed outside around or across Brant Island Shoal and up Jones Bay;

should the above cut be made this lumber would pass through it, the route being much shorter and more protected, and the resulting saving to the mill owners would be considerable.

Furthermore, there are a number of vessels engaged in the oyster business during the season, which convey their cargoes up the Pamlico River to Washington, N. C. Some of these oyster boats would find the route through the above cut more expeditious and less exposed.

It is also possible that ready and regular communications with a market would develop the trucking industry in the country in the neighborhood through which this cut would pass. This route will be seen to be of considerable local importance.

The following is an estimate of the present annual commerce carried over the route between Pamlico and Bay rivers, most of which would probably pass through this cut if made.

Carried by steamer:	
Cotton and products	$60,000
Grain, vegetables, and truck	5,000
General merchandise	60,000
	125,000
Lumber	10,000
Fish and oysters	200,000
Total	335,000

As stated above, it is believed that making this cut would develop the trucking industry, but further than this it is not thought that there would be any decided increase in commerce.

Hence the main advantage of this cut would be to provide a new and easier route which could be followed by shipping in all weathers and by which the difficult and sometimes dangerous passage around or across Brant Island Shoal could be avoided.

In addition to the above examination an incidental examination was made of a route across Brant Island Shoal between Brant Island and the mainland. This shoal consists apparently of hard sand.

It is thought that a route across this shoal can possibly be selected by which, with much less dredging than would be required for the above described cut, a boat passage could be provided with an available depth of 7 feet at mean low water.

A more extended examination would be required to determine the practicability and probable cost of this last-mentioned route.

This passage between Brant Island and the mainland would result in a considerable saving in time and distance to shipping and would be less exposed than the route at present followed.

Should any improvement of this waterway be decided upon a survey would be necessary to definitely locate the most available route. Such a survey would cost from $600 to $800.

The total cost of the preliminary examination upon which the above report is based was approximately $42.

Very respectfully, your obedient servant,

MASON M. PATRICK,
First Lieut. of Engineers.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

L 27.

PRELIMINARY EXAMINATION OF DRUM INLET, NORTH CAROLINA.

[Printed in House Ex. Doc. No. 164, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington D. C. January 7, 1891.

SIR: I have the honor to submit the accompanying copy of report, dated December 27, 1890, by Capt. William H. Bixby, Corps of Engineers, giving results of a preliminary examination of Drum Inlet, North Carolina, made in compliance with requirements of the river and harbor act approved September 19, 1890.

It is stated by Captain Bixby that the improvement of this inlet is of extremely doubtful practicability; the cost would be very great and the resulting benefits of a purely local character. For these reasons he is of the opinion that the locality is not worthy of improvement by the United States.

These views meet with the approval of the Division Engineer, Col. William P. Craighill, Corps of Engineers, and are concurred in by me.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF CAPTAIN W. H. BIXBY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 27, 1890.

GENERAL: In accordance with the river and harbor act of September 19, 1890, and letters and orders from your office dated September 20 and October 4, 1890, I have the honor to submit herewith the following report upon a preliminary examination of Drum Inlet, North Carolina.

This examination was made by Lieut. M. M. Patrick, United States Engineers, under my orders. His full report is appended. My opinions, as below stated, are based partly on his report and partly upon my own personal knowledge of the neighborhood. A fuller description of the prominent characteristics of these sounds and inlets is to be found in my past report on an examination of Ocracoke Inlet, North Carolina, in pages 1118 to 1124, Annual Report of Chief of Engineers for 1889.

Drum Inlet is one of several which formerly crossed the narrow strip of sand beach lying between the Atlantic Ocean and Core Sound at a point about 50 miles south of Cape Hatteras, 25 miles south of Ocracoke Inlet, and 25 miles north of Cape Lookout. All the inlets which, during the past 200 years, have at times existed between Ocracoke Inlet and Cape Lookout have been gradually closing under the effect of the southward drift of sand along this part of the coast. None of any account now remain; and this particular inlet has been practically closed for over 50 years. The beach at this point is now from 3,000 to 4,000 feet wide, and about 6.5 feet above mean low water, and is only submerged at exceptionally high storm tides. From the sound side of the beach to the channel way in Core Sound there is about a mile of shoal water of not more than 2.5 feet depth. Core Sound can be navigated only by vessels of not over 5-foot draft, and its greatest depth in deep pockets is only about 10 feet.

The advantage of an inlet at this point would be to open direct communication with the ocean to a fish and oyster commerce of from $200,000 to $375,000 per year, and to save to each vessel a 25 to 40 mile sail to the nearest existing inlets, Ocracoke on the north and Beaufort on the south. The increase in this commerce due to the reopening of this inlet might possibly amount to as much as $100,000 or $150,000 per year.

An inlet at this point would, however, only be available and of use to shallow-draft fishing boats, and could never be made as good or as useful as are already those of Ocracoke and Beaufort.

The first cost of reopening this inlet would be at least $36,000 for a 3-foot depth channel, and $85,000 for a 10-foot depth channel. Once opened, it would undoubtedly begin to shoal up again; it would probably be practically closed by the first heavy storm, and a large part of the work on the ocean side of the beach would probably have to be redredged at least once a year. Any system of jetties to preserve the inlet on the ocean side would be not only of doubtful utility, but of excessive cost.

In short, the reopening of this inlet is of extremely doubtful practicability, its benefits are purely local in nature, and its cost would be very great in comparison with the benefits resulting therefrom.

For these reasons I am of the opinion that Drum Inlet, North Carolina, is not worthy of improvement by the United States.

Very respectfully, your obedient servant,

W. H. Bixby,
Captain of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. Engineer Office,
Baltimore, Md., January 3, 1891.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 27, 1890, by the local engineer, I am of the opinion that Drum Inlet, North Carolina, is not worthy of improvement.

Wm. P. Craighill,
Colonel, Corps of Engineers.

REPORT OF LIEUTENANT M. M. PATRICK, CORPS OF ENGINEERS.

United States Engineer Office,
Wilmington, N. C., December 16, 1890.

Captain: I have the honor to submit the following report upon the preliminary examination of Drum Inlet, North Carolina, with a view to its improvement by the General Government, made in compliance with your orders to me dated November 11, 1890.

Information as to this locality was asked through newspapers and through circular letters sent to many persons supposed to be interested in the possible improvement. In answer to these letters and inquiries only a very few replies have been received.

The information embodied in the following report was obtained mainly by conversation with persons living in the vicinity and by my personal inspection of the locality.

For map of the localities described in the following report, see Coast Survey Chart No. 421.

A number of years ago Drum Inlet was one of several openings in the sandy barrier that separates the sounds along the North Carolina coast from the Atlantic Ocean, but by the shifting movement of the sands this inlet was gradually closed, so that since about the beginning of this century there has been no tidal ebb and flow through it except at unusually high storm tides.

Where the inlet formerly existed the beach is now from 3,000 to 4,000 feet wide, and the general level will average about 6½ feet above mean low water of the ocean.

This inlet, when in existence, was just opposite Thoroughfare Bay and about 25 miles south of Ocracoke Inlet; it connected Core Sound with the ocean.

At present, along this strip of beach there is no navigable inlet between Beaufort Harbor entrance and Ocracoke Inlet, a distance of about 45 miles.

On the sound side of the site of Old Drum Inlet a shoal extends from the low-water line to an average distance of about 1 mile, over which not more than 2¼ feet could be carried November 19, 1890.

I was informed that on this date the water surface was about the level of mean low water.

The bottom of the shoal is hard, compact sand.

Just north of the former position of the inlet two shallow creeks or sloughs make into the beach from the sound side and narrow the distance from sound to ocean to about 1,500 feet.

In August, 1889, a cut was started by the people of this section from the head of the more northern of these two creeks, the intention being to dig a ditch through the intervening strip of beach and thus connect the water of the sound directly with the ocean. This cut was made about 16 feet wide and dug below low-water level for a distance of about 500 feet; then the enterprise was abandoned. The ditch has filled up with sand, and where the cut was made the sand surface is at present about 2 feet above the level of low water.

The improvement desired by those who were instrumental in having this examination ordered is that the Government should cut through the strip of beach somewhere in the vicinity of Old Drum Inlet, and thus restore approximately the condition of things that existed before the inlet was closed.

This proposed improvement will be considered under the following heads:

(1) Its local importance or benefit.
(2) Its importance to shipping in general.
(3) The probable permanence of the cut if made.
(4) The cost of the proposed improvement.

(1) Nearly all the residents of the section of North Carolina bordering on these sounds are engaged during the season in the fish and oyster business. It is stated that since the closing of the Drum Inlet there has been a great deterioration in both the quality and quantity of the oysters taken from the sound and bays in this neighborhood; that clams, numerous before the inlet closed, are now very scarce, and that by reason of their inability to carry their boats through to the ocean residents of this neighborhood are unable to catch any of the outside fish which run in great numbers along this coast.

It is claimed that the opening of the proposed cut would increase at least 50 per cent. the annual business done by these fishermen and oystermen.

The following is an estimate of the present commerce of this vicinity: Along Core Sound, half way from Drum Inlet to Beaufort and half way from Drum Inlet to Ocracoke Inlet, a conservative estimate places the number of boats owned and engaged during the season in the oyster business at from 200 to 250, and the average catch of each boat is, in money value, about $1,000 to $1,500. This would make the annual commerce from $200,000 to $375,000, and the estimated increase, if the inlet were opened, from $100,000 to $187,500.

(2) It is possible, if at this locality there were an entrance *with good depth of water*, that such an inlet might be used to give access to a harbor of refuge for vessels plying along the coast. The maximum available depth in such harbor of refuge would, however, be not more than 10 feet at mean low water. It seems improbable that it would be used in any other way by outside vessels for the reasons that most of the outside shipping would find the routes through Ocracoke or Hatteras inlets or Beaufort Harbor entrance the most direct to their destinations, and also because the commerce through Core Sound is limited to vessels drawing not over 5 feet. Consequently it seems that commerce in general would be but little benefit by the opening of this inlet, and that in all probability but few boats, other than fishing crafts, would pass through this opening.

(3) From the very fact of the gradual natural closing of the old inlet and from the fact that instead of ever showing a tendency to reopen there has, in fact, been a continual building up of the beach in this vicinity, it must be argued that the probability would be slight of maintaining any opening at all at this point, much less of maintaining an opening with a good depth of water.

So far as can be learned, there has been no decided change in the local conditions governing the movement of the sands in this locality, since the time when the old inlet was closed.

In my opinion all things tend to show that such a cut would be of doubtful permanence and would require constant work or extensive training walls to keep it open.

(4) Should such a cut be decided upon, a short survey would be necessary to determine the most favorable locality for such a work.

The cost of such survey need not exceed $250.

My examination leads me to believe that the locality chosen by the people of this vicinity to begin the cut above mentioned is probably as good, if not better, than any other that could be selected, for the following reasons: The shoal on the sound side is narrower opposite this point, and the deeper water makes in closer to the beach. The beach at this point has about its minimum width and the amount of cutting would be the least.

The following is an estimate of the probable cost of the above-described improvement. Cut to be 100 feet wide and 3 feet deep at mean low water extending to the 3-foot contour on the sound side:

Dredging sand, 86,219 cubic yards, at 35 cents	$30,176
Contingencies, 20 per cent	6,035
Total	36,211

For cut 100 feet wide, 6 feet deep at low water, to 6-foot contour on sound side:

Dredging sand 138,199 cubic yards, at 35 cents	$48,369
Contingencies, 20 per cent	9,674
Total	58,043

For cut 100 feet wide, 10 feet deep at mean low water, to 10-foot contour on sound side:

Dredging sand, 200,866 cubic yards, at 35 cents	70,303
Contingencies, 20 per cent	14,060
Total	84,363

The above estimates of the amount of material to be removed are based on data obtained during my preliminary examination, and are believed to be approximately correct; the estimates of cost are based upon past work in this district.

The total cost of the preliminary examination upon which the above report is based was approximately $42.

Very respectfully, your obedient servant,

MASON M. PATRICK,
First Lieutenant of Engineers.

Capt. W. H. BIXBY.
Corps of Engineers, U. S. A.

L 28.

PRELIMINARY EXAMINATION OF HARBOR OF WASHINGTON, PAMLICO RIVER, NORTH CAROLINA.

[Printed in House Ex. Doc. No. 289, Fifty-first Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 27, 1890.

GENERAL: In accordance with the river and harbor act of the 19th September, 1890, and letter and orders from your office dated 20th September, and 4th October, 1890, I have the honor to submit herewith the following report upon a preliminary examination of the harbor of Washington, Pamlico River, North Carolina.

This examination was made by Lieut. M. M. Patrick, U. S. Engineers, under my orders. His full report is appended. My opinions, as below stated, are based partly on his report and partly upon my own personal knowledge of the neighborhood.

Washington, N. C., is a town of about 5,000 inhabitants at the mouth of the Tar River and at the head of the Pamlico River, North Carolina. Both rivers together have a length of 217 miles and a total drainage area of about 4,900 square miles. Both rivers have been under governmental improvement since 1876, and in this time their commerce has increased from $500,000 up to $4,800,000 per year, showing a development of over $60 annual commerce for each $1 once spent by the United States in their improvement, this being also accompanied by a reduction of from 12 to 50 per cent. in freight rates in the same interval. These good results are expected to continue increasing with further improvement of these rivers. Washington Harbor is the upper part of Pamlico River, and is practically the seaport or commercial outlet of both rivers.

The harbor opposite the city of Washington has plenty of depth. The place where improvement is necessary is at its lower end, below the city. At this point channels were dredged to 9 feet depth from 1879 to 1882, under appropriations for the improvement of the Pamlico River. These channels have shoaled somewhat in the past 10 years and need redredging to the extent of about $33,000 worth of work. Recommendations for the necessary appropriations would have ordinarily formed part of the next annual report on the Pamlico and Tar River improvement. Surveys to determine the exact amount and location of such work are already being made under Pamlico and Tar River appropriations. Channels of 9 feet depth are sufficient for any vessels that can at present reach the Pamlico River through any of the various canals or inlets that connect it with the ocean. Improvement of the harbor to this depth is regarded by me as worthy to-day as it has been for the past 10 years.

The people of Washington are, however, desirous that this harbor entrance should be further deepened to 10 or 12 feet to accommodate such vessels as it is expected will be able to reach Pamlico River from the ocean via Ocracoke Inlet as soon as the present improvement of the latter inlet permits their passage. Channels of suitable width (150 feet) and of 10 feet depth into Washington Harbor are estimated to cost at least $111,000. In my opinion they should be deferred until the work at Ocracoke has shown the desired results. Should these results at Ocracoke be reached, then Washington Harbor will, in my opinion, be worthy of improvement to at least 10 feet depth.

In short, for the above reasons, I am of the opinion that Washington Harbor is worthy of improvement to 9 feet depth of channel, but to no more at present. Special funds for surveys to determine the exact cost of such work are not necessary, as these surveys are already being made as part of necessary work under Pamlico and Tar River appropriations. The results of these surveys will be incorporated in my next annual report on the improvement of the Pamlico and Tar rivers, of which this harbor is a part. If, however, they are desired for prior publication, I desire to be so informed.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., January 3, 1891.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons set forth by the local engineer in his report of December 27, 1890, it is considered that the harbor of Washington, Pamlico River, North Carolina, is worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF LIEUTENANT MASON M. PATRICK, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., December 16, 1890.

CAPTAIN: I have the honor to submit the following report upon the preliminary examination of the harbor of Washington, N. C., with a view to its improvement by the General Government, made in compliance with your orders to me dated November 11, 1890.

Information as to this harbor was sought through newspapers and through circular letters sent to all parties supposed to be interested in the possible improvement. To these inquiries but few replies were received.

The information embodied in the following report was obtained mainly from the harbor commissioners of Washington, N. C.; from conversation with residents of Washington interested in the improvement of the harbor; from certain minor surveys made in the vicinity of Washington in connection with the work of improvement of the Pamlico and Tar rivers, and from my own personal inspection of the locality.

For map of the localities mentioned in the following report see Coast Survey Chart No. 144¹.

Washington, N. C., a town of about 5,000 inhabitants, is situated at the head of deep-water navigation of the Pamlico River, and since the Government undertook the improvement of this river it has rapidly increased in importance as a shipping and distributing point for goods and produce. New enterprises have been started, a considerable foreign trade has been built up, population and the value of real estate have increased, and it is stated that, if, after the improvement at Ocracoke Inlet (now in progress) is effected, vessels of greater draft can enter Washington Harbor, her commerce and general condition will be largely benefited.

The material prosperity of Washington has been almost entirely due to the Government improvement of the Pamlico and Tar rivers, and at present the town is almost entirely dependent upon water transportation. Fifteen steamers ascend the Pamlico River regularly to Washington, and four others make regular trips on the river above Washington. Besides these a large number of sailing vessels enter and leave the harbor.

Most of the steamers running to Washington pass through the Albemarle and Chesapeake Canal; the sailing vessels enter and leave Pamlico Sound by Hatteras or Ocracoke Inlets. The maximum draft that can be carried through the canal is about 8 feet, and the maximum draft that is generally carried through Ocracoke or Hatteras Inlets is about 9 feet.

The Pamlico River, practically an arm of Pamlico Sound, from its mouth 27 miles upward, has a broad, unobstructed channel, with a depth of at least 10 feet at mean low water. Thence, about 4 miles to Washington, the river gradually shoals and the channel becomes narrow and crooked.

On the 24th and 25th of November, 1890, when the water surface was about 0.3 foot above mean low-water level, a careful examination was made of this latter portion of the river—practically the entrance to the harbor of Washington—and a number of soundings were taken.

In past years two short channels have been dredged in the river, one immediately below, the other about 1 mile below the town. These channels were dredged to 9 feet below mean low water, and from the lower channel there were removed a number of large stumps. (See Annual Report of Chief of Engineers for 1880, pages 836 to 838, and for 1882, pages 1083 and 1084.)

My examination indicates some shoaling in these dredged channels, and it is reported that there are still some stumps in the lower channel that require removal. The shoaling amounts to about 1 foot to 1.5 feet and the material deposited seems to consist principally of soft mud and sand.

Consequently the available depth that can be carried into or out of this harbor is at present not more than 8 feet at mean low water, and considerable delay is frequently caused by the grounding of some of the larger classes of vessels that endeavor to use this harbor.

In addition to this lack of depth, the present channel is crooked and difficult to run.

The worst shoaling in the upper of the two dredged channels is near its upper end, where a shoal making off from the small island called the "Castles," opposite Washington, encroaches upon the channel.

After leaving the town of Washington, the channel at present followed by shipping is near the right bank of the river. Near the left bank of the river there is a false channel which ends about three-fourths of a mile below Washington, being separated from the harbor by the shoal at the mouth of Wind Mill and Runyon creeks. This channel was also examined and a number of soundings taken in it. My examination indicates that the depth in this false channel, up to near the above-mentioned shoal, will average about 1 foot more than the depth of the channel at present in use. The northern channel is broad, the bottom is mainly hard sand, and it is reported that there are few if any stumps to be met with.

The shoal at the mouth of the above-mentioned creeks appears to consist of hard, compact sand. There has apparently been but little change in it in a number of years, and it is probable that a channel cut through it would be fairly permanent.

The arguments advanced in favor of adopting this northern channel are that if an entrance to the harbor were provided by this route, cutting across the shoal at the mouth of these creeks, the water front of the town would be much improved; the new channel would be straighter; that piers and docks, which have to be extended some distance to reach the present deep-water channel, contract the harbor entrance and are obstructions to navigation by the smaller classes of vessels. Such piers would not have to extend so far to reach the deep water which would be provided by the proposed new channel.

In discussing the improvement of this harbor we must consider not only what is needed by the present commerce, but also what will be needed so soon as Ocracoke Inlet, now being improved by the Government, will permit vessels drawing from 10 to 14 feet to enter Pamlico Sound and ascend the Pamlico River.

(1) The present commerce: As stated above, Washington is largely dependent upon water transportation; the town is growing in importance as a shipping point; on account of the deterioration and crookedness of the present main ship channel considerable delay and difficulty are experienced by vessels entering and leaving the harbor. Since the two above-mentioned dredged channels were completed in 1877 no further improvement has been made in the harbor. At that date a minimum depth of 9 feet at mean low water was regarded as demanded by the then needs of commerce. My examination indicates that certainly no less depth than this, 9 feet at mean low water, will be sufficient to accommodate the present commerce, and also that it would be of great advantage to shipping now using the harbor if the channel were straightened.

(2) Future commerce: Ocracoke Inlet, one of the entrances from the ocean to Pamlico Sound, is at present under improvement by the Government, and it is believed that this improvement, when finished, will permit vessels drawing from 10 to 14 feet to enter and leave the sound. Such vessels can ascend the Pamlico River to within a short distance of Washington, but on account of the present lack of sufficient channel depth they can not enter the harbor.

There seems to be no doubt that the present commerce would be largely increased if such vessels could have access to this harbor, and consequently that just so soon as this improvement at Ocracoke is sufficiently advanced to permit the entrance to the sound of such vessels the needs of the commerce of Washington will demand a greater depth than 9 feet at mean low water.

I have deemed it best to make an estimate of the cost of improving both the present or southern channel and also the northern channel, so as to secure an available depth in either channel of (1) at least 9 feet at mean low water and (2) for a least depth of 10 feet at mean low water.

Present or southern channel: Channel to be straight, 150 feet wide, 9 feet deep at mean low water:

Dredging, approximately, 77,000 cubic yards, at 30 cents	$22,100
Removing stumps	5,000
Total	27,100
Contingencies, 20 per cent	5,420
Grand total	32,520

Northern channel, same dimensions as above:

Dredging 146,600 cubic yards, at 30 cents	$43,980
Removing stumps	1,500
Total	45,480
Contingencies, 20 per cent	9,096
Grand total	54,576

For improving present channel: Channel to be 150 feet wide and 10 feet deep at mean low water:

Dredging 275,000 cubic yards, at 30 cents	$82,500
Removing stumps, etc	10,000
Total	92,500
Contingencies, 20 per cent	18,500
Grand total	111,000

Improving northern channel to same dimensions, as provided in estimate immediately preceding:

Dredging 375,000 cubic yards, at 30 cents	$112,500
Removing stumps	2,500
Total	115,000
Contingencies, 20 per cent	23,000
Grand total	138,000

The above estimates of the amount of material to be removed are based on the data obtained during my preliminary examination and are believed to be approximately correct; the estimates of cost are based upon past work in this district.

The annual commerce of Washington, N. C., at present is estimated as follows:

Articles.	Exports.	Imports.	Total.
Cotton and products	$1,300,000		$1,300,000
Rice	10,000		10,000
Grain and forage		$100,000	100,000
Vegetables and truck	15,000		15,000
Fish and oysters	300,000		300,000
Naval stores	10,000		10,000
Lumber and products	450,000		450,000
General merchandise	100,000	2,500,000	2,600,000
Total	2,185,000	2,600,000	4,785,000

It is stated that if the additional depth is provided, and the entrance to the harbor of deeper draft vessels facilitated, an increase of from 10 to 25 per cent. may be expected in the above annual commerce.

Should this improvement be decided upon, a short preliminary survey would probably be necessary to accurately fix the limits of the needed dredging. Such a survey would probably cost not more than $300.

The total cost of the preliminary examination upon which the above report is based was approximately $42.

Very respectfully, your obedient servant,

MASON W. PATRICK,
First Lieutenant of Engineers.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

SUPPLEMENTARY REPORT.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 21, 1891.

GENERAL: In accordance with directions from your office dated 6th January, 1891, I have the honor to submit herewith a report on the survey of the harbor of Washington, Pamlico River, North Carolina, to accompany my report of 27th December, 1890, upon its preliminary examination. In that report this harbor was recommended as worthy of improvement to 9 feet depth of channel, and the statement was made that a survey of the harbor was then in progress in connection with the general improvement of the Pamlico and Tar rivers, of which this harbor forms a part. This survey has now been completed sufficiently to show the work necessary to obtain the above-recommended channel way.

The channel which will be the least expensive, natural, and at the same time most advantageous to general navigation will occupy a location coinciding very nearly with the existing route of navigation as marked upon the Coast Survey charts, and as partially improved in past years. The existing Coast Survey charts show the general condition of the river and present channel with an exactness sufficient for the uses of this report, and so no special map is deemed necessary. All that appears necessary is to straighten and deepen the present route, especially at its worst places. The local circumstances, as brought out by the recent survey, cause me to recommend the same depth, 9 feet at ordinary low water, as in my report on the preliminary examination, but to now recommend a channel width of 200 feet.

The cost of this work is estimated as follows:

Length.	Width.	Average depth of cutting.	Total cutting.	Cost.
Feet.	*Feet.*	*Feet.*	*Cubic yards.*	
2,900	200	1.9	40,814	....
2,400	200	1.5	26,667	....
3,250	200	1.9	45,741	....
Estimated at 33⅓ cents per cubic yard....................			113,222	$37,740
Superintendence and contingencies, about 20 per cent......			....	7,260
Total cost....................................			....	45,000

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

L 29.

PRELIMINARY EXAMINATION OF WHITE OAK RIVER, FROM ROBERTS LANDING TO COLLINS CROSSING, NORTH CAROLINA.

[Printed in House Ex. Doc. No. 97, Fifty-first Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., November 25, 1890.

GENERAL: I have the honor to submit herewith the following report upon the examination of White Oak River, from Robert Landing to Collins Crossing, North Carolina, ordered by river and harbor act of September 19, 1890, and assigned to me by letters and orders from your office dated September 20 and October 4, 1890.

The White Oak River was examined by me in person under the provisions of the river and harbor act of August 11, 1888, and was then recommended as worthy of improvement for steamboats from its mouth upward 29 miles to near Sabistons Bridge, and thence for flat boats 21 miles further to Collins Ford (or Collins Crossing), at a total estimated cost of $45,000, to be (for advantageous work) voted at the rate of about $10,000 or more per year. Robert Landing (otherwise called Foscue Landing) is about 4 miles below Sabistons Bridge. No funds have as yet been voted for this work. The full report upon this examination is to be found printed in pages 1127 to 1129, Part II, Annual Report of the Chief of Engineers, United States Army, for 1889. Since this examination and report there have been no special changes or developments at the White Oak River to cause any special change in the above report and its recommendations.

From that report it will be seen that the above-named portion of this river from Robert Landing (or Foscue Landing to Collins Crossing (or Collins Ford) is already recommended for improvement, as follows:

For steamboat navigation:	
Robert Landing, 4 miles to Sabistons Bridge	$500
For flat-boat navigation:	
Sabistons Bridge, 21 miles to Collins Crossing	3,000
	3,500
Superintendence and contingencies, 30 per cent	1,050
Total	4,550

For advantageous work this amount should be voted in a single sum. Smaller appropriations will increase considerably the final cost of the work.

I have the honor to herewith repeat the above recommendations and to refer to the former report (as above quoted) for fuller details.

Respectfully submitted.

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Second indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 12, 1890.

Respectfully returned to the Chief of Engineers.

Because of the facts and reasons set forth in the report of November 25, 1890, by the local engineer, and following the decision of the Chief of Engineers (see page 148, Part I, Annual Report of 1889) ,and having in view the present and prospective needs of commerce, I have to state, as required by the act approved September 19, 1890, that White Oak River from Robert Landing to Collins Crossing, North Carolina, is considered worthy of improvement by the General Government.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

L 30.

PRELIMINARY EXAMINATION OF BLACK RIVER, SOUTH CAROLINA, FROM KINGSTREE TO ITS MOUTH.

[Printed in House Ex. Doc. No. 286, Fifty-first Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 21, 1891.

GENERAL: In accordance with the river and harbor act of 19th September, 1890, and letters and orders from your office dated 20th September and 4th October, 1890, I have the honor to submit herewith the following report upon a preliminary examination of Black River, South Carolina, from Kingstree to its mouth, this report having been held back some in hopes of thereby receiving fuller and more detailed commercial statistics.

This examination was made by Lieut. M. M. Patrick, Corps of Engineers, under my orders. His full report is appended. My own report is based mainly upon the information gathered and reported by Lieutenant Patrick, checked and assisted by my own personal knowledge of individual points of the river in detail and the surroundings of the entire river in general.

The Black River, South Carolina, is a stream of about 200 miles total length and 1,200 square miles of drainage area. The portion below Kingstree has a length of about 120 miles (35 miles in air line), lies between low banks, except occasionally where bluffs of from 5 to 30 feet height border the stream for short distances on one or the other side, and has so gentle a slope that the average current does not exceed 2 miles per hour. Fuller details are given in the report of Lieutenant Patrick.

At present a steamer runs over the lower 40 miles of river, making regular weekly or semiweekly trips, and carrying about $1,200,000 of annual commerce, most of which comes from Mingo Creek, one of the tributaries of the river. On the upper 80 miles of the river the present commerce is only about $100,000 per year, but it is estimated that this might readily be increased to $500,000 per year if the river were properly cleared out by the mere removal of snags and fallen trees from its channel and leaning and overhanging trees from its banks, at a cost of not over $25,000, thus developing $16 of annual commerce for each $1 once spent in the improvement. Greater development than this has already in the past 10 years been obtained from the clearing out of similar neighboring streams.

Prior to 1865 a steamer ascended this river 118 miles as far as Kingstree, and up to 1880 another small steamer made many trips up 52 miles to Potato Ferry; but the difficulties and dangers of navigation caused the enterprise to be abandoned.

The lands on both sides of the river are well suited to agriculture and in great need of better and cheaper transportation facilities, the cost of haulage to the nearest railroad and freight therefrom to the nearest market being so great as to prevent the development and fuller cultivation of the greater part of the river basin near the river. The clearing up of the river in the method and at the cost above given, would permit light-draft navigation during about 6 months of the busy shipping time of the year when transportation is most needed.

The upper portion of the river is crossed by three wooden bridges and one iron bridge; but the latter, however, is only 1 mile from Kingstree by land (though 2 miles by river) so that boats going to Kingstree can load and unload to advantage below this latter bridge. I do not therefore regard this latter bridge as an unreasonable obstruction to navigation.

Under these circumstances I regard the Black River, South Carolina, as worthy of improvement by the General Government so far as to clear out its natural obstructions, such as snags, fallen and overhanging trees, etc., from its mouth upward 118 miles to the railroad bridge at Kingstree, at a total expense of $25,000.

The above estimates are based upon past work on similar rivers of the neighborhood. They include allowances for necessary superintendence and contingencies, and they are herewith submitted as being a sufficient indication of the amount of the needed appropriations. Surveys and more precise estimates for individual features of the work can be advantageously postponed until work is in actual progress on this part of the river.

For advantageous and economical work, this amount should be voted at the rate of about $10,000 or more per year. Smaller or irregularly voted appropriations will involve the alternate disorganization and reorganization of working parties, extra superintendence, deterioration of plant, and extra cost of moving plant over long distances to and from the place of work, and may considerably increase the final cost of the work.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., February 24, 1891.

Respectfully submitted to the Chief of Engineers.

It is considered that Black River, South Carolina, from Kingstree to its mouth, is worthy of improvement so far as includes the removal of snags, fallen and overhanging trees, etc.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF LIEUTENANT MASON M. PATRICK, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., January 19, 1891.

CAPTAIN: I have the honor to submit the following report upon the preliminary examination of Black River, South Carolina, from Kingstree to its mouth, with a view to its improvement by the General Government, made in compliance with your orders to me dated 11th November, 1890.

An examination of the same portion of this same river was provided for by act of Congress of 14th June, 1880; an examination was made in December, 1880, by Mr. Chas. W. Forster under the orders of Capt. Chas. B. Phillips, Corps of Engineers; a map of the river was submitted by Captain Phillips, and his report, embodying that of Mr. Forster, is found in the Report of the Chief of Engineers for 1881, pages 1040–1042. For reasons stated in his report Captain Phillips regarded this stream as not worthy of improvement at that time.

A blue print of the above mentioned map was used by me while making my examination.

Information as to this water way was sought through newspapers and through circular letters sent to many parties supposed to be interested in the possible improvement. To these inquiries but few replies were received.

The information embodied in the following report was obtained mainly from conversation with parties living along the stream, from the above-mentioned report of Captain Phillips, and from my own personal inspection of the river from Kingstree to its mouth, part of this inspection being made in a small canoe and part in a steam launch drawing about 3 feet.

Black River, South Carolina, is a stream about 200 miles total length and 1,200 square miles of drainage area; it rises in Kershaw County, S. C., and empties into the Great Peedee River at a place called Kinloch Bay, about 4¼ miles above Georgetown, S. C. The portion examined, from Kingstree to its mouth, has a length of about 120 miles (35 miles in an air line). The following report refers entirely to this last-mentioned portion of the river.

The Black River is a winding, crooked stream, flowing in general between low marshy banks, the river in freshets spreading out over the swamp. Occasionally bluffs varying in height from 5 to 30 feet, border the stream for short distances on either side.

The current runs at an average rate of about 1.5 to 2 miles an hour, being swiftest in the narrow winding portions of the river and slowest in the pools and long reaches.

At the time of my examination the river was reported to be about 2.5 feet above the low-water summer stage, and to be about the stage of average winter water. Extreme freshets rise from 7 to 9 feet above summer low water.

Between the Upper Kingstree Bridge and its mouth, this stream is crossed by two wooden county bridges, one wooden bridge owned by private parties, and one iron railroad bridge; all these bridges are unprovided with draws; the railroad bridge is 2 miles by river from the Kingstree Upper Bridge and only about a mile in a direct line from the town; boats loading or discharging at Kingstree need not pass above this bridge.

The effects of lunar tides are felt for from 50 to 60 miles above the mouth of the river.

From Pinetree Landing, 80 miles below Kingstree, to its mouth the river needs little, if any, improvement; its width varies from 150 to 1,000 feet; the minimum channel depth is about 6 feet at low water.

Above Pinetree Landing, all the way to Kingstree, the entire river is badly obstructed by snags, fallen and leaning trees, and numerous sand shoals. Many of these sand shoals are caused by the river being choked with snags, and it is probable that if the snags were removed the condition of most of these shoals would be improved.

For a distance of about 10 miles above Pinetree the river is very badly obstructed. This portion of the river is called The Narrows; there are numerous sharp bends, many leaning trees, and the river is choked with snags; the width in many places is not over 50 to 60 feet; the current swift, the banks low, the river running through a thick cypress swamp; the average depth at summer low water in this portion of the river is not over 18 inches; for probably 6 months in the year the depth would average from 2.5 feet to 3 feet. The upper end of the Narrows is about 1½ miles below Potato Ferry (Kallehan).

Above the Narrows for a distance of about 9 miles the river is broader, averaging from 75 to 100 feet in width, and the average depth is about 2 feet at summer low water; there are many snags and leaning trees, which would have to be removed if the river was opened for navigation; then for 4 miles over a portion of the river called Steels Narrows, the condition of the river is very much the same as at the Narrows already described. From the upper end of Steels Narrows to Kingstree upper bridge the river varies in width from 60 to 125 feet; the depth at summer low water averages about 1 foot; there are numerous snags and leaning trees, and some trees standing in the river.

At the Kingstree Lower Bridge, 15 miles below the upper bridge, rock crops out on the right bank, and there is some rock in the bed of the river. At Horse Ford, 60 miles below Kingstree, some rock is found in the bed of the river, but at this point the depth is about 1.5 feet at summer low water.

In the above-mentioned report of Mr. Forster it is stated that rock was found at several places in the Narrows; soundings were taken at these places and no rock was found, the bottom of the river being soft sand. It is probable that rock may underlie this sand, but it certainly would not interfere with navigation.

The following table shows the features of the river more in detail and gives an estimate of the cost of improvement so far as to remove all snags and leaning trees, clearing the channel of the river to its natural dimensions, and permitting light-draft steam navigation during the seasons of winter high water, about 5 or 6 months during each year:

Name of locality.	Observed.				
	Distance.		Water way.		
	From Kingstree Upper Bridge.	Intervals.	Width of stream.	Depth in channel.	Current per hour.
	Miles.	*Miles.*	*Feet.*	*Feet.*	*Miles.*
Kingstree:					
Upper Bridge	....	....	60	3.5	2
Railroad Bridge	2	2	60–70	3–4.5	2
Lower Bridge	18	16	60–100	3.5	2
Browns Bridge	39	21	75–120	4	2
Smiths Bridge	48	9	75–150	4.5	2
Steels Narrows	56	8	75–180	4	2
Lower end Steels Narrows	60	4	50–80	3.5	2.5
Potato Ferry	68	8	100–150	5	1.5
Upper end the Narrows	69	1	140	3	1.5
Pinetree Landing	80	11	50–75	3.5	2.5
Mouth of river	120	40	100–1000	6+	....

Name of locality.	Observed.					Reported height of water at time of examination above summer low water.	Estimate of cost of improving by snagging and clearing to present natural dimensions.
	Curvature of river.		Banks.				
	Bends per mile.	Diameter of bends.	Height of right bank.	Height of left bank.	Height of freshet mark.		
Kingstree:	*No.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
Upper Bridge			6	12	7	2.5	
Railroad Bridge	4	1000–2000	0–	10	7	2.5	$400
Lower Bridge	3	200–1000	0–20	0 –20	7	2.5	3,200
Brown's Bridge	3	300–5280	0–20	0 –10	7	2.5	4,000
Smith's Bridge	2	400–5000	0–10	0 –10	7	2.5	1,800
Steels Narrows	3	400	0–10	0.5–10	6	2.0	1,600
Lower end Steels Narrows	3	350	0–	0 –10	6	2.0	1,600
Potato Ferry	2	500	0–10	0 – 5	6	2.0	1,600
Upper end the Narrows	1	1,000	0– 5	0 –10	6	2.0	200
Pinetree Landing	4	100–300	0–	0 –	6	2.0	4,500
Mouth of river							1,500
Total							20,400
Superintendence and contingencies, 20 per cent							4,080
Total for 120 miles of river							24,480

In former years a small steamboat ran on this stream as high as Kingstree, but no steam craft has ascended the river to this point since 1865; up to 1884 a steamer made regular trips between Georgetown and Potato Ferry; at present the only steam navigation on the river is from the mouth of Mingo Creek down, a small steamer which runs up Mingo Creek passing over this portion of the river; with this exception, the entire commerce of the river is carried by rafts and flats, and these rafts and flats experience much difficulty in making trips, owing to the numerous snags in the river.

The lands along Black River are well suited to agriculture; there is considerable timber standing within easy reach of the banks.

The country along the river is much in need of better and cheaper transportation facilities; most of the produce has to be hauled from 2 to 12 miles to reach the nearest railroad.

The present commerce that passes over Black River is estimated as follows:

Exports:	
Rice	$200,000
Cotton	400,000
Naval stores	50,000
Lumber and cross ties	60,000
Total	710,000
Imports:	
General merchandise and fertilizers	650,000
Total exports and imports	1,360,000

This total includes about $300,000 which enters or leaves the river between its mouth and the mouth of Mingo Creek; about $960,000 which enters or leaves the river at the mouth of Mingo Creek; of the remaining $100,000, $90,000 enters or leaves the river between the mouth of Mingo Creek and Potato Ferry; the remaining $10,000 is the present commerce of the river between Potato Ferry and Kingstree.

To this commerce may properly be added the amount which would come from the country above Potato Ferry if the river were opened sufficiently to admit of steam navigation; this is estimated as follows:

Exports:	
Cotton (4,000 bales)	$200,000
Lumber	25,000
Naval stores	5,000
Total	230,000
Imports:	
General merchandise and fertilizers	200,000
Total exports and imports	430,000

Very respectfully, your obedient servant,

MASON M. PATRICK,
First Lieutenant of Engineers.

Capt. W. H. BIXBY,
Corps of Engineers.

APPPENDIX M.

IMPROVEMENT OF LUMBER AND WACCAMAW RIVERS, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

REPORT OF CAPTAIN FREDERIC V. ABBOT, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Waccamaw River, North and South Carolina.
2. Lumber River, North and South Carolina.
3. Little Pedee River, South Carolina.
4. Great Pedee River, South Carolina.
5. Clark River, South Carolina.
6. Mingo Creek, South Carolina.
7. Santee River, South Carolina.
8. Wateree River, South Carolina.
9. Congaree River, South Carolina.
10. Harbor at Charleston, South Carolina.
11. Ashley River, South Carolina.
12. Wappoo Cut, South Carolina.
13. Edisto River, South Carolina.
14. Salkahatchie River, South Carolina.
15. Beaufort River, South Carolina.
16. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATION.

17. Wateree River, South Carolina, from Camden to the falls of the Catawba, also of the bend or curve in said river about 4 miles below Camden, between the plantations of Witte and Williams, to determine if it is advisable in the interest of navigation to make a cut-off across the neck of said bend.

United States Engineer Office,
Charleston, S. C., July 7, 1891.

General: I have the honor to transmit herewith the annual reports for the fiscal year ending June 30, 1891, for the works of improvement of rivers and harbors which have been in my charge.

Very respectfully, your obedient servant,

Frederic V. Abbot,
Captain of Engineers.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

M I.

IMPROVEMENT OF WACCAMAW RIVER, NORTH AND SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 818, Annual Report for 1880. For map of river see page 1200, Annual Report for 1889.

ORIGINAL CONDITION.

In 1880 this stream was navigable for 12-foot boats at all stages of water from Georgetown, 23 miles, to Bull Creek, and at high water 4 miles farther to Buck's Lower Mills; thence for 7-foot draft boats at high water, 22 miles farther to Conway; thence it possessed an obstructed channel for 3-foot draft boats at ordinary winter water, 68 miles to Reeves Ferry; thence an obstructed channel with 3 feet at high water for 30 miles to Lake Waccamaw.

PLAN OF IMPROVEMENT.

The project provides for a channel 12 feet deep at all stages of water with 80 feet bottom width, from the mouth of the river to Conway; thence a cleared channel to Lake Waccamaw, at an estimated cost of $138,400.

WORK PRIOR TO JUNE 30, 1890.

At Eight Shoals jetties made of piles and plank were put in. The river had been snagged between points no miles and 117 miles above the mouth, 2,106 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 6,640 overhanging trees having been taken from the banks.

WORK OF PAST YEAR.

Work has been continued with a hoister and crew hired from Mr. Thomas W. Daggett, of Conway, S. C. The river has been quite thoroughly cleared for a width of 40 feet and depth of 3 feet at low water between points 49 miles and 101 miles above the mouth. The average cost of removing obstructions from the channel was $1.17 each; overhanging trees, etc., removed from the banks cost 80 cents each. For details of work done and commercial statistics reference is made to the report of my assistant engineer, Mr. Reid Whitford, who has shown his usual ability in conducting the work.

REMARKS.

One new transportation line has been established on this river during the year. Parties using the river report much benefit from the work done by the United States.

With the balance of $4,199.54 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. During the year the freight passing over this stream has aggregated 76,245 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
approved June 14, 1880	$15,000
approved March 3, 1881	10,000
passed August 2, 1882	4,400
approved July 5, 1884	6,000
approved August 5, 1886	15,000
of August 11, 1888	15,000
approved September 19, 1890	12,500
Total	77,900

Total expenditures, including June 30, 1891, $73,700.46.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer; table of commercial statistics, furnished by the collector of Georgetown, S. C.

Money statement.

July 1, 1890, balance unexpended	$224.87
Amount appropriated by act approved September 19, 1890	12,500.00
	12,724.87
June 30, 1891, amount expended during fiscal year	8,525.33
July 1, 1891, balance unexpended	4,199.54
July 1, 1891, outstanding liabilities	1,120.60
July 1, 1891, balance available	3,078.94
Amount (estimated) required for completion of existing project	60,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Waccamaw River, North and South Carolina, for fiscal year ending June 30, 1891.

WORK.

Snagging and clearing banks were begun November 21, 1890, at Conway, S. C., by steam hoister and crew hired from Mr. Thomas W. Daggett. The following obstructions have been removed, quite thoroughly clearing a channel to an approximate width of 40 feet and depth of 3 feet at low water:

From the channel: Logs, 1,556; stumps, 895; large snags, 288; small snags, 10 cords. From the banks: Trees cut, 5,900; brush cut, 106 cords.

Work was carried on between points 49 miles and 101 miles above mouth of river. Of the total amount expended four-tenths were used on channel and six-tenths on banks. Each obstruction cost approximately 92 cents.

REMARKS.

The owners and captains of steamers continue to express themselves as being highly pleased with the work.

Mr. Daggett has shown his usual untiring energy in his efforts for the success of the improvement. One water gauge was kept till January 1, 1891, and then discontinued.

RECOMMENDATIONS.

It is respectfully recommended that work be carried on above Conway as it has been this year, and the channel below Conway be maintained at least at its present width and depth.

COMMERCE.

The following statement is made up from the best information that could be obtained from Mr. D. T. McNeil, Messrs. W. L. Buck & Co., and H. L. Buck, large lumber and shingle manufacturers on the river, and Mr. L. S. Ehrich, President of Georgetown Board of Trade, also, Capt. Thomas W. Daggett.

COMMERCIAL STATISTICS.

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.	*Tons.*	
Rosin, 76,000 barrels	13,300	$228,000
Tar, 557 barrels	56	1,114
Spirits turpentine, 12,000 barrels	2,250	240,000
Turpentine, crude, 6,000 barrels	840	15,000
Cotton, 5,500 bales	1,875	275,000
Timber, 9,547 sticks	14,826	40,980
Lumber, 8,800,000 feet	18,333	122,000
Shingles, 9,800,000	4,900	78,400
Rice, rough, 122,000 bushels	2,684	152,500
Rice, clean, 12,000 barrels	1,950	195,000
Miscellaneous articles, such as tallow, eggs, wax, game, poultry, etc	1,231	128,118
	61,245	1,481,112
INWARD FREIGHTS.		
General merchandise	15,000	750,000
Total	76,245	2,231,112

This shows a slight increase over last year, and would indicate the trade on the river to be in a healthy condition. One new line of transportation has been added. The commerce has been carried on by sea-going vessels of about 350 to 400 tons, and steamers of from 15 to 300 tons. Considerable commerce is carried on by pole boats and rafts of which no account whatever could be obtained.

EMPLOYÉS.

Much credit is due Mr. C. J. Banta, timekeeper, for his usual efficient and neat work.

Mr. J. D. Mayo, master machinist, in charge of all United States machinery under this office, has been especially faithful and successful in the discharge of his duties, and he is recommended as an excellent machinist and a thoroughly good, reliable runner of marine machinery.

Very respectfully, your obedient servant,

REID WHITFORD.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrival and clearances of vessels and commerce at Georgetown, S. C., from January 1, 1888, to December 31, 1890.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1888	352	124,155	2,818	2	479	14	1	81	8	355	124,715	2,840
1889	365	128,705	2,920	2	424	10	1	149	7	368	129,278	2,943
1890	385	165,785	3,150	6	1,346	42	1	106	6	392	167,237	3,198

CLEARED.

Year.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1888	342	121,715	2,735	8	1,835	55	1	81	8	351	123,631	2,798
1889	357	126,965	2,856	6	1,494	45	1	149	7	364	128,608	2,908
1890	372	160,458	3,069	9	1,978	63	2	355	13	383	162,791	3,145

Commerce, foreign and domestic.

Year.	Value of exports.	Value of imports.	Duties collected.
1888	$3,125,000	$2,750,000	$32.44
1889	3,265,000	2,975,000	....
1890	3,454,000	3,175,000	60.54

Total commerce, 1888	$5,875,000
Total commerce, 1889	6,240,000
Total commerce, 1890	6,629,000

R. O. BUSH.

M 2.

IMPROVEMENT OF LUMBER RIVER, NORTH AND SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 1102, Annual Report for 1887.
For map of river, see page 1198, Annual Report for 1890.

ORIGINAL CONDITION.

The river was obstructed by logs, snags, stumps, overhanging trees, and in places by sand bars. Long reaches were in fair condition. That portion of the river between Lumberton and the North Carolina line was crossed by five low bridges without draw spans, and one moderately high railroad bridge near Lumberton. In South Carolina the river is crossed by two bridges without draws. The Enterprise Land and Lumber Company had a charter allowing them to control the navigation of the river and the right to improve it.

PLAN OF IMPROVEMENT.

The project provides for improving the river for steamboats from its mouth to Lumberton, a distance of 70.8 miles, by snagging and clearing the banks, at an estimated cost of $35,000. No work was to be done on this river until the charter of the Enterprise Land and Lumber Company was transferred to the United States free of cost.

WORK PRIOR TO JUNE 30, 1890.

Several papers transferring the charter rights of the Enterprise Land and Lumber Company were offered by the company, but were found to be defective in form by the Department of Justice. On June 30, 1890, the last transfer paper, which had been made out by one of the officers of the Department of Justice, had not been returned signed. No work had been done on the river, but a plant had been constructed. The parties operating the low bridges in North Carolina had begun work on their draw-spans, but had not finished them. A stadia survey of the river from Lumberton to its mouth had been made.

WORK OF PAST YEAR.

The parties operating the Fair Bluff and Ivy Bluff bridges have provided satisfactory draw-spans. The bridges at Griffins and Mathews have been discontinued. The bridge at Phillips will be provided with a draw as soon as the county commissioners operating it can raise the necessary funds. The river was quite thoroughly cleared by plant owned and operated by the United States for a width of 40 feet and depth of 3 feet at low water between points no miles and 71 miles above the mouth. The average cost of removing obstructions from the channel was 63 cents each; overhanging trees, etc., removed from the banks, cost 43 cents each. For details of work done, reference is made to the appended report of my assistant engineer, Mr. Reid Whitford, who has shown marked ability in directing and controlling the working parties and maintaining the efficiency of the plant.

REMARKS.

Two small steamers have run irregularly on this river during the year. A large saw, planing, and shingle mill, with a capacity of 140,000 feet of lumber a day, has been constructed on the river at Bee Bluff. During the year freights passing over this stream have aggregated 5,100 tons.

With the balance of $4,356.94 on hand July 1, 1891, snagging will be continued as far as the funds will admit, removing the worst obstructions first.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is the port of entry. Amount of duties collected in the calendar year of 1890, $60.54

For this improvement the following appropriations have been made:

By act of Congress—	
Of August 11, 1888	$5,000
Approved September 19, 1890	5,000
Total	10,000

Total expenditures, including June 30, 1891, $5,643.06.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's Annual Report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$2,884.23
Amount appropriated by act approved September 19, 1890	5,000.00
	7,884.23
June 30, 1891, amount expended during fiscal year	3,527.29
July 1, 1891, balance unexpended	4,356.94
July 1, 1891, outstanding liabilities	300.10
July 1, 1891, balance available	4,056.84
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Lumber River, North and South Carolina, for fiscal year ending June 30, 1891:

WORK.

Snagging and clearing banks were begun at Lumberton, N. C., the head of navigation, at a point 71 miles above the mouth of the river, August 13, 1890, by United States hand hoister and hired labor. The following obstructions have been removed, roughly clearing banks and channel to an approximate width of 40 feet and depth of 3 feet at low water:

From the channel: logs, 1,231; stumps, 167; large snags, 1,036; small snags, 66½ cords. From the banks: trees cut, 3,472; brush cut, 226½ cords.

The work has been carried on between points 71 miles and 0.25 mile above the mouth of the river. Of the total amount expended five-tenths were used on channel and five-tenths on banks. Each obstruction cost, approximately, 51 cents.

REMARKS.

It is respectfully recommended that work be continued as heretofore. Much more will be required to place the river in proper condition for safe steamboat navigation.

One water gauge was kept on the river till January 1, 1891, and then discontinued.

COMMERCE.

Such statement as could be obtained is given below. It was collected by B. T. Daggett, overseer, who made special trips up and down the river, under orders from this office, visiting the principal shipping points and soliciting information on the subject from the most prominent business men.

Statement.

Articles.	Quantity.	Value.
	Tons.	
Timber, 3,000 sticks	4,500	$12,600
Fertilizer	100	2,000
General merchandise	500	25,000
Total	5,100	39,600

The commerce has been carried on by pole boats and timber rafts, as all the bridges over the river are not yet supplied with draw openings to admit of steamboat navigation, two of them having been so provided, namely, at Fair Bluff and Ivy Bluff, N. C. Last year there was no commerce on the river. It has therefore increased by about 5,100 tons.

The shipments to and from Lumberton, N. C., by railroad consist of about 1,500 barrels spirits turpentine, 7,000 barrels of rosin, 6,000 bales of cotton, 300 barrels tar, and 900 carloads of general merchandise. To and from Fair Bluff, another town on the river, the shipments are about the same by railroad as to Lumberton.

To and from Nichols, the only other town near the river, distant about 1 mile, the shipments are about 2,700 bales cotton, 1,200 barrels spirits turpentine, 6,000 barrels rosin, and 2,900 tons general merchandise. The aggregate exports and imports by rail, according to the above, amount to 19,975 tons, valued at about 1,205,200.

The Messrs. Butters, of Michigan, have built and put in operation at Bee Bluff, on the river, one of the largest saw and shingle mills in the South. They have two small steamers in use for towing logs.

EMPLOYÉS.

Mr. B. T. Daggett, overseer, deserves credit for the efficient and economical manner of managing the field work. He has been well assisted by Mr. J. T. Haywood, suboverseer.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 3.

IMPROVEMENT OF LITTLE PEDEE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination see page 1111, Annual Report for 1887.
For map of river, see page 1214, Annual Report for 1890.

ORIGINAL CONDITION.

The river was much obstructed by snags and overhanging trees, and in places was divided into several branches, in neither of which there was a good channel, and by ten bridges without draws.

PLAN OF IMPROVEMENT.

It is proposed to snag the river and close unnecessary branches, providing for steamboat navigation up to the mouth of Lumber River and pole-boat navigation thence to Little Rock, at an estimated cost of $50,000.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points no miles and 113 miles above the mouth; 2,367 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 3,110 overhanging trees, etc., having been cut from the banks.

WORK OF PAST YEAR.

The river was quite thoroughly cleared by plant owned end operated by the United States, for a width of 40 feet and depth of 3 feet at low water, between points no and 30½ miles above the mouth. The average cost of removing obstructions from the channel was 63 cents each; overhanging trees, etc., removed from the banks cost 23 cents each. For details of work done and commercial statistics reference is made to the report of my assistant engineer, Mr. Reid Whitford, who has showed marked ability in directing and controlling the working party and maintaining the efficiency of the plant.

REMARKS.

One new transportation line has been established on this river during the year, and a steamer has run somewhat irregularly part of the time. Parties using the river report much benefit from the work done by the United States.

With the balance of $2,861.59 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. During the year the freight passing over this stream has aggregated 4,614 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
Of August 11, 1888	$5,000
Approved September 19, 1890	5,000
Total	10,000

Total expenditures, including June 30, 1891, $7,138.41.

The following paper accompanies this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's annual report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$417.22
Amount appropriated by act approved September 19, 1890	5,000.00
	5,417.22
June 30, 1891, amount expended during fiscal year	2,555.63
July 1, 1891, balance unexpended	2,861.59
July 1, 1891, outstanding liabilities	279.32
July 1, 1891, balance available	2,582.27
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations upon Little Pedee River, S. C., for fiscal year ending June 30, 1891:

WORK.

Snagging and clearing banks were continued by United States hoister and hired labor. The following obstructions have been removed, roughly clearing banks and channel to an approximate width of 40 feet and depth of 3 feet at low water.

From the channel: Logs, 823; stumps, 468; large snags, 407; small snags, 44¾ cords. From the banks: trees cut, 1,896; brush cut, 110¾ cords.

Work was carried on between points no miles and 30¼ miles above mouth of river. Of the total amount expended seven-tenths was used on the channel and three-tenths on the banks. Each obstruction cost approximately 42 cents.

REMARKS.

The river has been very much improved by the United States work, as those running boats state. There is still much left to be done before the channel is thoroughly cleared of obstructions. One water-gauge was kept on river till January 1, 1891, and then discontinued.

RECOMMENDATIONS.

It is respectfully recommended that the same character of work be continued till a thoroughly cleared channel be completed from its mouth to Little Rock, the head of navigation.

COMMERCE.

The following statement was made up by information furnished by H. L. Buck, J. E. Dusenbury & Co., S. J. Hennery, and other business men near the river:

Commercial statistics.

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.		
	Tons.	
Rosin, 3,920 barrels	686	$5,880
Spirits turpentine, 408 barrels	77	8,160
Cotton, 310 bales	78	15.500
Ton timber, 2,200 sticks	3,300	9,240
Shingles, 30,000	15	240
	4,156	39,020
INWARD FREIGHTS.		
General merchandise	458	13,740
Total	4,614	52,760

This shows an increase of 1,353 tons over last year. The commerce has been carried on by one steamer of 80 tons, pole boats, and rafts. One new line of pole boats has been added.

EMPLOYÈS.

Mr. J. W. Harllee, overseer, S. M. Stevenson, engine driver, and J. P. Rumley, timekeeper, have been very faithful in the discharge of their duties. Especially is credit due Overseer Harllee for this.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 4.

IMPROVEMENT OF GREAT PEDEE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 753, Annual Report for 1873. For special description, see page 845, Annual Report for 1880, and page 723, Annual Report for 1879. For map of river, see page 1180, Annual Report for 1889.

ORIGINAL CONDITION.

The river was dangerously obstructed by snags and logs everywhere. Boats drawing 9 feet of water were able to reach Smith Mills, 52 miles above the mouth. Those drawing 3½ feet at low water could get 54 miles further up, to Little Bluff, or at high water to Cheraw, 172 miles from the mouth.

PLAN OF IMPROVEMENT.

The project provides for a thoroughly cleared 9-foot navigation to Smith Mills, and a 3½-foot navigation to Cheraw at all stages of water, at an estimated cost of $117,000.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points no miles and 172 miles above the mouth since June 30, 1884, 4,610 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 9,250 overhanging trees, etc., having been cut from the banks. Before June 30, 1884, the records are not detailed enough to give exact figures.

WORK OF PAST YEAR.

The river was quite thoroughly cleared by plant owned and operated by the United States, for a width of 80 feet and a depth of 9 feet at low water, between points no miles and 50 miles above the mouth, and for a width of 80 feet and depth of 4 feet at low water between points 50 miles and 172 miles above the mouth. The average cost of removing obstructions from the channel was $1.46 each; overhanging trees, etc., removed from the banks cost $1 each. For details of work done and commercial statistics, reference is made to the report of my assistant engineer, Mr. Reid Whitford, who has shown marked ability in directing and controlling the working party and maintaining the efficiency of the plant.

REMARKS.

One new transportation line has been established on this river during the year. Parties using the river report much benefit from the work done by the United States. With the balance of $9,460.98 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. During the year the freight passing over this stream has aggregated 62,344 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
Approved June 14, 1880	$7,000
Approved March 3, 1881	6,000
Passed August 2, 1882	6,000
Approved July 5, 1884	8,000
Approved August 5, 1886	20,000
Of August 11, 1888	20,000
Approved September 19, 1890	12,500
Total	79,500

Total expenditures, including June 30, 1891, $70,039.02.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see the appendix of the report of this year for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$3,158.21
Amount appropriated by act approved September 19, 1890	12,500.00
	15,658.21
June 30, 1891, amount expended during fiscal year	6,197.23
July 1, 1891, balance unexpended	9,460.98
July 1, 1891, outstanding liabilities	466.67
July 1, 1891, balance available	8,994.31
Amount (estimated) required for completion of existing project	37,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C. June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Great Pedee River, South Carolina, for fiscal year ending June 30, 1891.

WORK.

Snagging and clearing banks continued by United States steam hoister and hired labor. The following obstructions have been removed, roughly clearing banks and channel to an approximate width of 80 feet and depth of 3 feet at low water:

From the channel: Logs, 648; stumps, 71; large snags, 361; small snags, 2 cords. From the banks: Trees cut, 1,034; brush cut, 20 cords.

Work has been carried on between points 27 miles and 166 miles above mouth of river.

Of the total amount expended six-tenths were used on channel, and four-tenths on banks. Each obstruction cost approximately $1.23.

The progress of the work was greatly delayed by unusually high freshets during the winter.

REMARKS.

The improvement of the river by the United States work has been decided, as captains of river steamers and others in a position to know freely state. Three water gauges were kept until January 1, 1891, and then discontinued.

RECOMMENDATIONS.

It is respectfully recommended that the same character of work be carried on till a thoroughly cleared channel be completed from mouth of river to Cheraw.

COMMERCE.

The following statement was obtained by Mr. J. C. Tamplet, timekeeper, who, acting under orders from this office, visited all the principal shipping and receiving places along the river, and from them collected the figures given:

Statement.

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.		
	Tons.	
Cotton, 5,926 bales	$1,483	$296,300
Clean rice, 16,342 barrels	2,656	265,558
Rough rice, 83,000 bushels	1,827	103,750
Rosin, 35,800 barrels	6,265	50,120
Spirits turpentine, 4,014 barrels	652	80,280
Cypress shingles, 6 705,987	3,353	53,640
Cypress lumber, 3,000,000 feet	6,250	45,000
Cypress logs, 22,547 feet	33,821	81,169
Wood, cord, 225 cords	226	563
Hides, wool, staves, etc	250	7,500
	56,782	983,880
INWARD FREIGHTS.		
General merchandise	5,562	383,450
Total	62,344	1,367,330

This shows an increase of approximately 8,336 tons over that given in 1890. Commerce has been carried on by sea-going schooners of 250 to 300 tons, and tugboats to Port Harrelson and Smith Mills, and the steamers *Santee*, *Merchant*, and *John M. Cole* to Cheraw, the head of navigation.

There has been one new steamboat line of transportation established.

EMPLOYÉS.

Mr. Homer Jacobs, overseer; Mr. John R. Smith, engine driver, and Mr. J. C. Tamplet, timekeeper, deserve credit for faithful and efficient services.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 5.

IMPROVEMENT OF CLARK RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 1109 Annual Report for 1887. For map of river, see page 1204 Annual Report for 1890.

ORIGINAL CONDITION.

This creek is really the southern mouth of Lynch River. Its upper end was entirely choked by a tangled mass of driftwood and fallen trees. The lower part was fairly clear of obstructions.

PLAN OF IMPROVEMENT.

The project provides for closing the northern mouth of Lynch River and thoroughly snagging Clark Creek, at an estimated cost of $7,500.

WORK PRIOR TO JUNE 30, 1890.

The first 3 miles from the mouth was quite thoroughly cleared of obstructions for a width of 40 feet and depth of 3 feet at low water. The remaining three-fourths of a mile was roughly worked over. The last 590 feet next to Lynch River being solidly packed with logs for the entire width of the stream, a passage 25 feet wide was all that could be provided with the money on hand, and this was so shoal that it could only be used during freshets. One thousand and seventy-four obstructions, consisting of logs, snags, etc., were taken from the channel, and 230 overhanging trees, etc., were cut from the banks. A survey of the creek was made.

WORK OF THE PAST YEAR.

No work has been done during the year as the creek has remained high most of the time, and the appropriation is so small that it is necessary to do the work at dead low water in order to derive any benefit from it.

REMARKS.

With the balance of $2,261.68 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. No freight has passed over the creek during the year, and none can be expected until the improvement can be pushed all the way through.

This creek is tributary to the collection district of Georgetown, S. C. Georgetown is the port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
Of August 11, 1888	$2,500
Approved September 19, 1890	2,500
Total	5,000

Total expenditures, including June 30, 1891, $2,738.32.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's Annual Report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$36.07
Amount appropriated by act approved September 19, 1890	2,500.00
	2,536.07
June 30, 1891, amount expended during fiscal year	274.39
July 1, 1891, balance unexpended	2,261.68
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report relative to Clark Creek, South Carolina, for fiscal year ending to-day:

WORK.

Owing to continuous high water nothing has been done under the appropriation of September 19, 1890. The amount available being so small a favorable stage of water for advantageous work had to be awaited in order that the best results might be obtained for the least amount expended. It is thought that during the present summer and coming fall the water will be sufficiently low to permit snagging and bank trimming to be carried rapidly on in a most beneficial manner.

REMARKS.

The creek when once fairly opened will be of great convenience to the people living on Lynch River, of which Clark Creek is the best outlet into the Great Pedee River. There is much valuable timber and fertile, well-cultivated land along Clark Creek and Lynch River.

RECOMMENDATIONS.

It is respectfully recommended that the work of snagging and clearing banks be continued till an unobstructed channelway be provided. In addition to this a timber dam be built across Lynch River to keep out the drift which enters that river from the Great Pedee during freshets.

COMMERCE.

There is some through the creek at intervals during the year, when the water is sufficiently high to allow timber, rafts, and pole flats loaded with naval stores to float over the log-jams in the creek. Just how much it amounts to no account could be obtained, and no reliable estimate formed.

* * * * * * *

EMPLOYÉS.

There has been no one employed during the year, but there is no better place than this to say that Mr. William Alden James, clerk, deserves special mention for his most efficient and valuable assistance in the efforts made to carry out your orders concerning all works in local charge of this office.

Very respectfully your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 6.

IMPROVEMENT OF MINGO CREEK, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination see page 1106, Annual Report for 1887. For map of river see page 1202, Annual Report for 1890.

ORIGINAL CONDITION.

The creek was much obstructed by snags and overhanging trees, and was crossed by one bridge without a draw.

PLAN OF IMPROVEMENT.

The project provides for improving the creek for steamboats from its mouth to Williams Landing, and for pole boats at high water up to the head of navigation, by snagging and clearing the banks, at an estimated cost of $17,000.

WORK PRIOR TO JUNE 30, 1890.

The creek was snagged between points 13 miles and no miles above the mouth, 741 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 3,310 overhanging trees, etc., having been cut from the banks. The parties operating the Mingo Bridge had put in a draw span.

WORK OF PAST YEAR.

The creek was quite thoroughly cleared by plant owned and operated by the United States, for a width of 40 feet and depth of 4 feet at low water, between points no miles and 13 miles above the mouth. The average cost of removing obstructions from the channel was $1.08 each; overhanging trees, etc., removed from the banks cost $0.27 each. For details of work done and commercial statistics reference is made to the report of my assistant engineer, Mr. Reid Whitford, who has showed marked ability in directing and controlling the working party, and maintaining the efficiency of the plant.

REMARKS.

No new transportation lines have been established on this creek during the year. Parties using the creek report much benefit from the work done by the United States.

With the balance of $3,077.67 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. During the year the freight passing over this stream has aggregated 42,875 tons.

This creek is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of—	
Congress of August 11, 1888	$5,000
Congress approved September 19, 1890	5,000
Total	10,000

Total expenditures, including June 30, 1891, $6,922.33

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's Annual Report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$1,068.28
Amount appropriated by act approved September 19, 1890	5,000.00
	6,068.28
June 30, 1891, amount expended during fiscal year	2,990.61
July 1, 1891, balance unexpended	3,077.67
July 1, 1891, outstanding liabilities	259.32
July 1, 1891, balance available	2,818.35
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Mingo Creek, South Carolina, for fiscal year ending June 30, 1891:

WORK.

Snagging and clearing banks were continued by United States hand hoister and hired labor. The following obstructions have been removed, quite thoroughly clearing the banks and channel to an approximate width of 40 feet and depth of 4 feet at low water:

From the channel: Logs, 537; stumps, 248; large snags, 257; small snags, 27 cords. From the banks: Trees cut, 2,412; brush cut, 444 cords.

Work has been carried on between points no miles and 13½ miles above mouth of creek. Of the total amount expended six-tenths were used on channel and four-tenths were used on banks. Each obstruction cost, approximately, $0.49.

REMARKS.

The improvement made in the navigation of the creek has been very great, as those in a position to know freely state.

RECOMMENDATIONS.

It is respectfully recommended that the same character of work be carried on till a thoroughly cleared channel be completed.

COMMERCE.

The accompanying letter and statement from Messrs. F. Rhem & Sons on this subject explain themselves. The above-mentioned firm controls a large portion of the commerce on the creek, and are in a position to know more about the value of the exports and imports than any other persons. The commerce has been carried on by one steamer of 100 tons, and a number of pole boats, rafts, etc. The total freights carried have increased by about 13,302 tons over last year. There has been no new line of transportation established, but those running have made more trips.

EMPLOYÉS.

Mr. F. A. Haddock, overseer, and Mr. J. D. Sturgeon, timekeeper, have shown their usual zeal and efficiency in the discharge of their duties.

COMMERCIAL STATISTICS.

RHEMS, S. C., *May 1, 1891.*

DEAR SIR: We give you below a statement of the commerce of "Mingo Creek," South Carolina, from May 1, 1890, to May 1, 1891, showing the exports and imports. You will readily see from reference that the continued improvements are still increasing the exports and imports. While there is yet a large amount of work to be done before completed, the steamers and other boats have had a successful year, getting heavy freights both ways.

We can truly say that Mr. F. A. Haddock and his assistant, Mr. J. D. Sturgeon, are doing good work and are faithful servants.

Yours, very respectfully,

F. RHEM & SONS.

Mr. REID WHITFORD,
U. S. Assistant Engineer.

Exports and imports.

Articles.	Quantity.	Value.
EXPORTS.	*Tons.*	
Spirits turpentine, 11,000 barrels	2,750	$220,000
Rosin, 66,000 barrels	11,550	145,000
Crude turpentine, 5,000 barrels	1,000	25,000
Wood, 6,000 cords	6,000	15,000
Staves, 350,000	700	1,400
Hoop poles, 50,000	50	5,000
Cotton, 4,500 bales	1,125	202,500
Shingles, 600,000	300	5,000
Other produce including wool	400	20,000
Lumber, cross-ties, etc	12,000	60,000
Total	35,875	698,900
IMPORTS.		
General merchandise brought up	7,000	350,000
Total	42,875	1,048,900

Excess of exports, $348,900.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 7.

IMPROVEMENT OF SANTEE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For description of river see page 916, Annual Report for 188 new project see page 1184, Annual Report for 1889. For map see page 1186, Annual Report for 1889.

ORIGINAL CONDITION.

This river was considerably obstructed at all stages of water by logs and snags. Its bar entrance was narrow, crooked, and sl with only about 4 feet of water at low tide. Four steamers and small vessels were then running upon portions of the river.

PLAN OF IMPROVEMENT.

The project of 1880 proposed to provide the river with a good through Mosquito Creek to Winyaw Bay, by deepening and strai ing this creek to 50 feet width and 7 feet depth to secure 7-foot n tion in the river from its mouth 120 miles to Wright Bluff, and t 5-foot navigation 23 miles farther, to the head in the Congare Wateree Rivers.

The revised project of 1889 provides for leaving the Mosquito Canal, which has been completed 30 feet wide and 3 feet deep, timber route; cutting a new canal between Estherville and Minim large enough for river steamers, and snagging the entire river, estimated cost of $350,000.

WORK PRIOR TO JUNE 30, 1890.

A passage 30 feet wide and 3 feet deep at high water through quito Creek to Winyaw Bay had been made; the excavation amou to 201,038 cubic yards.

WORK OF PAST YEAR.

A small amount of snagging was done upon the river proper badly obstructed bend by plant owned and operated by the Un States. The average cost of removing obstructions was 84 cents.

Dredging on the new cut between Estherville and Minim Creek be under contract with Mr. Louis S. Ehrich, of Georgetown, S. C. A doing considerable work he asked and was granted permission to pend operations in order to enable him to make some improvements alterations in his dredge. At the end of the year they were about pleted, and dredging will soon begin again.

Work on the flood gate in the old Mosquito Creek Canal was be and nearly completed at the close of the fiscal year.

For details of work done and commercial statistics reference is m to the report of my assistant engineer, Mr. Reid Whitford, who shown marked ability and zeal in conducting the work.

REMARKS.

No new transportation lines have been established on this river duri the year. Parties using the river report much benefit from the w done by the United States.

With the balance of $26,890.88 on hand July 1, 1891, dredging will be continued upon the Estherville-Minim Creek route; the flood gate will be completed in the Mosquito Creek Canal, and some further snagging may be done on the river proper, if it shall seem to be required by the best interests of navigation.

During the year the freight passing over this stream has aggregated 100,255 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
Approved March 3, 1881	$22,000
Passed August 3, 1882	20,000
Approved July 15, 1884	15,000
Approved August 5, 1886	18,750
Of August 11, 1888	24,000
Approved September 19, 1890	30,000
Total	129,750

Total expenditures, including June 30, 1891, $102,859.12.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's annual report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended		$5,257.66
Amount appropriated by act approved September 19, 1890		30,000.00
		35,257.66
June 30, 1891, amount expended during fiscal year		8,366.78
July 1, 1891, balance unexpended		26,890.88
July 1, 1891, outstanding liabilities	$1,950.29	
July 1, 1891, amount covered by uncompleted contracts	23,821.12	
		25,771.41
July 1, 1891, balance available		1,119.47
Amount (estimated) required for completion of existing project		320,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging between Estherville and Minim Creek, South Carolina.

[Opened November 21, 1890.]

No.	Name of bidder.	Quantity.	Price, deposited on marsh.
		Cubic yds.	*Per cu. yd.*
1	Louis S. Ehrich	70,000	$0.37½
2	P. Sanford Ross	70,000	.45

Date of commencing work and monthly progress, as required by specifications. Contract awarded to Louis S. Ehrich, of Georgetown, S. C., at the price stated.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFIC
Georgetown, S. C., June 30,

CAPTAIN: I have the honor to make the following report of operations on
River, South Carolina, for fiscal year ending June 30, 1891:

WORK.

On the Santee River proper some snagging and bank trimming was done b
of the United States hoisters. It was done between points 41 and 42 miles abo
mouth of the river, and amounted to, from the channel: Logs, 133; stumps, 7;
of small snags, 1½. From the banks: Trees cut, 141; cords of brush cut, 2½.

There was expended on this work, $241.14, each obstruction costing approxim
$0.84.

Contract was made with Mr. Louis S. Ehrich, of Georgetown, S. C., to d
dredging under the appropriation of September 19, 1890, on the Estherville-M
Creek Line. Mr. Ehrich began at the Estherville or Winyaw end, excavating
40 feet wide, January 1, 1891, as the contract required. After removing 6,477
yards work was suspended to make alterations and improvements in his dredge.
has about completed them and will very soon recommence excavating, and no re
can be seen why the work then can not go on expeditiously.

By the terms of the right of way the United States is required to restore the
land irrigation damaged by the canal work. An informal agreement was ent
into with Mr. W. C. Johnstone to restore 5,510 linear feet of irrigating canal thro
Estherville plantation. To date he has completed of this 3,700 linear feet.

A survey and map were made of the line from Minim Creek, at the Santee Ri
to Winyaw Bay, and the canal as proposed staked off. A copy of the map is h
with sent.

An agreement was entered into with Mr. Henry E. Eaddy to construct a flood g
in Mosquito Creek Canal. Mr. Eaddy has the work well started and will compl
it at an early day.

REMARKS.

The snagging was done on the Santee, where a place in the river was badly chok
with logs and fallen timber. High water prevented further snagging during t
year. * * * One water gauge was kept till January 1, 1891, and then disco
tinued.

RECOMMENDATIONS.

It is respectfully recommended that no more snagging be done on the Santee wi
the present appropriation unless specially requested by the steamboat managers th
the work be carried on as rapidly as possible on the new canal line; that the old rou
at Mosquito Creek be put in somewhat better condition than it is now and so mai
tained till at least the new route is ready for use by the public. This will probabl
require the expenditure of about $5,000 out of each appropriation.

COMMERCE.

The accompanying statement of commerce is furnished by Mr. L. S. Ehrich, president of the Georgetown Board of Trade.

Mr. Ehrich says that he takes great care to have them as correct as it is possible to get them. He has given the statistics for this river his personal attention for several years past, and he is in the position, being engaged in large cross-tie and lumber business on the Santee River, to know more about the commerce than anyone else in this place. The total freights carried show a decrease of about 17,332 tons, but an increase in money value of $577,600.

There have been no new lines of transportation established, but the steamers running on the river from 200 to 300 tons burden have been running regularly. Large quantities of valuble cypress timber have come through the United States Canal at Mosquito Creek.

EMPLOYÉS.

I am much indebted to Mr. H. F. Price, surveyor and inspector, for his usual most excellent, efficient, and faithful work.

LETTER FROM MR. L. S. EHRICH, CHAIRMAN GEORGETOWN BOARD OF TRADE.

PALMETTO CYPRESS COMPANY,
Georgetown, S. C., May 26, 1891.

DEAR SIR: Complying with your request, I beg to submit herewith statistics as to Santee River. The past year having been a good one for all farm products, the shipments show a considerable increase. This will vary from year to year, and much depends upon the seasons.

I would respectfully call your attention to increased timber receipts and to say further that we have just arrived at the point where the improvement made by the United States Government has begun to manifest itself, giving facilities to timber getters to market their logs.

This section of country has been visited and inspected during the past 12 months by many Western lumber dealers and land speculators, resulting in sales of over 65,000 acres of swamp land along the river at steadily increasing prices.

One Chicago firm has purchased a mill site at Georgetown and many thousand acres on Santee River, and will at once erect a large plant.

There is no better way to illustrate the value of these cypress swamps than by this statement: One log alone, which was brought to Georgetown to-day, measured 52 inches at small end, was 62 feet long, contained 560 cubic feet, and brought $50.40. This log came through the Government Cut, and measured over 8 feet at butt end. The amount of available timber, not only cypress but yellow pine and many hard woods, exist in such quantities along Santee River that to those who have examined it there can exist no doubt but what with the completion of the Minim Creek Government Cut, as recommended by the U. S. Engineers, and the success of the jetties now started on our bar, Georgetown will be the largest lumber market on the Atlantic coast.

A steamer is now being built to ply between points on the Santee River and Georgetown which will much facilitate commerce and add greatly to the manufacture of shingles and railroad ties along the river.

For want of any other mode of transportation railroad ties have up to this time been brought here in rafts at great expense and much risk. The majority of logs, as shown in the following report, have been received in the past 4 weeks. The Palmetto Cypress Company have purchased in 20 days 3,700 pieces at an average of 7½ cents per cubic foot.

Very respectfully,

Louis S. Ehrich,
Chairman Georgetown Board of Trade.

Reid Whitford,
Assistant Engineer.

Commercial statistics for year ending May 26, 1891.

Articles.	Quantity.	Value.
OUTWARD.	*Tons.*	
Cotton, 20,000 bales	5,000	$850,000
Rosin, 140,000 barrels	24,500	175,000
Spirits, 25,000 barrels	4,687	350,000
Timber, 12,000 pieces	18,000	60,000
Shingles, 3,000,000	1,500	15,000
Lumber, 2,000,000 feet	3,333	20,000
Railroad ties, 23,000	1,610	6,900
Wool, 50,000 pounds	25	15,000
Hides, 15,000 pounds	8	1,500
Seed oats, 7,000 bushels	210	4,200
Rice, 100,000 bushels	2,200	150,000
Staves, 500,000	500	2,500
Wood, 10,000 cords	10,000	12,000
Game and fish	15	1,500
	71,588	1,663,600
INWARD.		
Fertilizers	*7,500	225,000
Groceries, provisions, etc	*11,667	350,000
Dry goods	*4,000	225,000
Boots, shoes, etc	*4,000	200,000
Hardware implements, machinery	*1,500	80,000
Total	100,255	2,743,600

* Value of these tons is necessarily estimated.

Note.—Outward tons added by myself, the others by Mr. Ehrich.

Very respectfully, your obedient servant,

Reid Whitford,
Assistant Engineer.

Capt. Frederic V. Abbot,
Corps of Engineers, U. S. A.

M 8.

IMPROVEMENT OF WATEREE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 914, Annual Report for 1880. For map of river, see page 1190, Annual Report for 1889.

ORIGINAL CONDITION.

In 1882 this stream had a low-water depth of from 3 to 4 feet from its mouth, 68 miles, to Camden. The lower 14 miles was completely blocked at all stages of water by logs, snags, etc., and at moderate stages by the bridges of the South Carolina and the Wilmington, Columbia, and Augusta Railroads, then without draw-spans; thence to Camden, navigation was possible, but dangerous, except during high water. Its commerce was practically nothing.

PLAN OF IMPROVEMENT.

The project provides for safe and unobstructed 4-foot navigation for steamers from Camden to the mouth at an estimated cost of $60,000.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points 68 miles and no miles above the mouth since 1884, 2,768 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 3,873 overhanging trees, etc., having been cut from the banks. Previous to June 30, 1884, the records are not sufficiently detailed to give exact figures, but a very considerable amount of work had been done on the river.

WORK OF PAST YEAR.

The river was quite thoroughly cleared, by plant owned and operated by the United States, for a width of 80 feet and depth of 4 feet at low water between points no miles and 68 miles above the mouth. The average cost of removing obstructions from the channel was 96 cents each; overhanging trees, etc., removed from the banks cost 72 cents each. For details of work done and commercial statistics, reference is made to the appended report of my assistant engineer, Mr. Reid Whitford, who has shown marked ability in directing and controlling the working parties and maintaining the efficiency of the plant.

REMARKS.

Two steamers have been running regularly on this river during the year. Parties using the river report much benefit from the work done by the United States. The appropriation of September 19, 1890, completes the amount that this improvement was estimated to cost. By the expenditure of this sum the entire portion of the river covered by the project has been put into good condition for steamboat navigation. For its maintenance the snag boat owned by the river should be kept at work continuously. The stream is well worth this expense, which would amount to about $6,500 a year. If appropriations are made every 2 years $13,000 could be advantageously spent in that period.

With the balance of $13,640.39 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first.

During the year the freight passing over this stream has aggregated 1,005 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	Approved March 3, 1881	$8,000
	Passed August 2, 1882	15,000
	Approved July 5, 1884	5,000
	Approved August 5, 1886	7,500
	Of August 11, 1888	12,000
	Approved September 19, 1890	12,500
Total		60,000

Total expenditures, including June 30, 1891, $46,359.61.

The following papers accompany this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's Annual Report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$7,729.28
Amount appropriated by act approved September 19, 1890	12,500.00
	20,229.28
June 30, 1891, amount expended during fiscal year	6,588.89
July 1, 1891, balance unexpended	13,640.39
July 1, 1891, outstanding liabilities	451.77
July 1, 1891, balance available	13,188.62
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	6,500.00

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Wateree River, South Carolina, for fiscal year ending June 30, 1891:

WORK.

Snagging and clearing banks were continued by United States steam hoister and hired labor. The following obstructions have been removed, roughly clearing the banks and channel to an approximate width of 80 feet and depth of 4 feet at low water:

From the channel: Logs, 696; stumps, 356; large snags, 1,361; cords small snags, 56½. From the banks: Trees cut, 2,108; cords brush cut, 80.

Work has been carried on between points no miles and 55 miles above mouth of river. Of the total amount expended six-tenths were used on the channel and four-tenths on the banks. Each obstruction cost, approximately, 85 cents.

REMARKS.

The progress of the work was greatly delayed by continuous high freshets during the spring and winter. The work so far accomplished has been of marked benefit to the navigation of the river, as the captains of the steamers state.

Two water gauges were kept till January 1, 1891, and then discontinued.

RECOMMENDATIONS.

It is respectfully recommended that work of a similar character be carried on till a thoroughly cleared channel from mouth of river to Camden be completed. After this has been done, there will be required about $6,000 per year or $12,000 from one appropriation to the other, as they are at present made by Congress, to keep the channel open, owing to the large quantities of drift coming down the river, lodging and forming obstructive jams. In addition, erosion of the banks during freshets, causes much of the standing timber to fall in.

COMMERCE.

The following statement was obtained by Mr. E. C. Easterling, timekeeper, who acting under orders from this office, visited all the principal shipping and receiving places along the river, and from them collected the figures given.

Statement.

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.	*Tons.*	
Cotton, 415 bales	104	$20, 750
Cotton-seed oil, 270 barrels	54	3, 780
Cotton-seed meal	27½	605
Cotton-seed hulls	10	25
Rosin, 1,000 barrels	175	1, 250
Rough rice, 10,000 bushels	220	12, 500
Cotton seed, 1,000 bushels	15	300
		39, 210
INWARD FREIGHTS.		
General merchandise	400	12, 000
Total	1, 005½	51, 210

Last year there was no commerce on the river, but during the present year the South Carolina Steamboat Company had a line of steamers running, of from 250 to 300 tons burden, and they have been running quite regularly, and carrying freights in apparently paying quantities. The commerce is fast growing in importance. The river runs through the most fertile farming lands in the State.

EMPLOYÉS.

Capt. Kilbia Morse, overseer, and Mr. E. C. Easterling, timekeeper, have as usual been very faithful and efficient in the discharge of their duties.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 9.

IMPROVEMENT OF CONGAREE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination see page 1140 Annual Report for 1885. For map of river see page 1194 Annual Report for 1889.

ORIGINAL CONDITION.

In 1886 this stream had a low-water depth of 3 to 4 feet from its mouth to the railroad bridge at Columbia; thence 1 foot low-water depth 2 miles farther to its head. Navigation of the lower 47 miles was blocked at all stages of water by the South Carolina Railroad Bridge and by sunken logs, snags, and overhanging trees. The navigation of the remaining 2 miles was prevented by swift currents and numerous rock ledges and bowlders. Its commerce was nothing.

PLAN OF IMPROVEMENT.

The project proposes to secure a thoroughly cleared 4-foot navigation over the lower 47 miles at all stages, and a cleared channel 100 feet wide through the shoals above, at an estimated cost of $54,500.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points no miles and 47 miles above the mouth, 1,542 obstructions, consisting of logs, snags, etc., having been taken from the channel, and 780 overhanging trees, etc., having been taken from the banks.

WORK OF PAST YEAR.

The river was quite thoroughly cleared by a plant owned and operated by the United States for a width of 80 feet and a depth of 3 feet at low water, between points no miles and 47 miles above the mouth. The average cost of removing obstructions from the channel was $1.27 each; overhanging trees, etc., removed from the banks cost 48 cents each. For details of work done and commercial statistics reference is made to the report of my assistant engineer, Mr. Reid Whitford, who has shown marked ability in directing and controlling the working party and maining the efficiency of the plant.

REMARKS.

No new transportation lines have been established on the river during the year. Parties using the river report much benefit from the work done by the United States.

With the balance of $2,575.19 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first. During the year the freight passing over this stream has aggregated 2,401 tons.

This river is tributary to the collection district of Georgetown, S. C. Georgetown is its port of entry. Amount of duties collected in the calendar year of 1890, $60.54.

For this improvement the following appropriations have been made:

By act of Congress—	
Approved August 5, 1886	$7,500
Of August 11, 1888	7,500
Approved September 19, 1890	5,000
Total	20,000

Total expenditures, including June 30, 1891, $17,424.81.

The following paper accompanies this report:

Report of Mr. Reid Whitford, assistant engineer.

For table of commercial statistics furnished by the collector of Georgetown, S. C., see this year's report for Waccamaw River.

Money statement.

July 1, 1890, balance unexpended	$2,089.01
Amount appropriated by act approved September 19, 1890	5,000.00
	7,089.01
June 30, 1891, amount expended during fiscal year	4,513.82
July 1, 1891, balance unexpended	2,575.19
July 1, 1891, outstanding liabilities	647.74
July 1, 1891, balance available	1,927.45
Amount (estimated) required for completion of existing project	34,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1891.

CAPTAIN: I have the honor to make the following report of operations on Congaree River, South Carolina, for fiscal year ending June 30, 1891:

WORK.

Snagging and clearing banks were continued by United States steam hoister and hired labor. The following obstructions have been removed, roughly clearing the banks and channel to an approximate width of 80 feet and depth of 3 feet at low water:

From the channel: Logs, 746; stumps, 180; large snags, 487; small snags, 62. From the banks: Trees cut, 913; brush cut, 58 cords.

Work has been carried on between points 0 miles and 28 miles above mouth of river. Of the total amount expended eight-tenths were used on the channel and two-tenths on the banks. Each obstruction cost approximately 96 cents.

REMARKS.

The progress of the work was greatly delayed by continuous high freshets during the winter and spring. The work so far done has been of marked benefit to the navigation of the river, as the captains of the river steamers state. Two water gauges were kept till January 1, 1891, and then discontinued.

RECOMMENDATIONS.

It is respectfully recommended that similar work be carried on till a thoroughly cleared channel be completed from the mouth of the river to Granby Landing, near Columbia; afterward to maintain the channel as completed.

COMMERCE.

The following statement, in the main, was obtained by Mr. R. G. Dusenbury, overseer (the cotton, spirits turpentine, general merchandise, and tons added by myself), who, acting under orders from this office, visited all the shipping and receiving places along the river, and from them collected the figures given:

Statement.

	Quantity.	Value.
OUTWARD FREIGHTS.	*Tons.*	
Cotton, 100 bales	25	$5,000
Spirits turpentine, 218 barrels	41	4,360
Rosin, 8,200 barrels	1,435	11,480
	1,501	20,840
INWARD FREIGHTS.		
General merchandise	900	27,000
Total	2,401	47,840

This shows an increase of 171 tons over last year.

There is considerable commerce, consisting of saw-logs, shingles, etc., of which no account and no estimate could be formed. This river is the city of Columbia's water outlet to the ocean. There have been no new transportation lines established, but a steamer of greater carrying capacity, 200 to 300 tons, has been run. The Congaree flows through an exceedingly fertile country, and a large and important commerce will by proper management flourish on it.

EMPLOYÉS.

Mr. R. G. Dusenbury, overseer, and Mr. J. E. Norman, engine driver, deserve credit for efficient and faithful work.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 10.

IMPROVEMENT OF HARBOR AT CHARLESTON, INCLUDING SULLIVANS ISLAND AND MOUNT PLEASANT SHORE, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For history of operations up to June 30, 1888, see page 970, Annual Report for 1888. For modified project, including estimates, see page 1150, Annual Report for 1889.

ORIGINAL CONDITION.

There were four channels across the bar, the deepest having about 12 feet at low water.

PLAN OF IMPROVEMENT.

It is proposed to establish and maintain, by means of two jetties, a low-water channel of not less than 21 feet across the bar. The action of the jetties is to be assisted by dredging. The estimated cost of the project is $4,380,500, if the jetties are left at mean low-water level throughout. If brought up to 3 feet above mean low-water level throughout, $5,334,500.

WORK PRIOR TO JUNE 30, 1890.

The foundations of both jetties had been completed out to the crest of the bar. Log mattresses loaded with stone were used throughout as foundation and to some extent as hearting. Considerable portions of both jetties had been raised to mean low water.

The following material had been used:

	Stone.		Mattresses.
	Tons.	*Cu. yds.*	*Sq. yds.*
North jetty	22, 644	122, 335	175, 155
South jetty	34, 012	143, 414	306, 585
Total	56, 656	265, 749	481, 740

A plant for quarrying and depositing stone had been in part procured for work by hired labor, in addition to that by contract.

WORK OF PAST YEAR.

Messrs. Grant & Egan completed their stone contract on February 12, 1891, having deposited 43,264 tons during the fiscal year. Mr. B. C. Howell continued dredging under his contract till November 8, 1890, removing and dumping 47,626 cubic yards between July 7 and November 8, inclusive. On the latter date his dredge was libeled for debt, and up to the close of the fiscal year he had been unable to resume work. On November 18, 1890, proposals were opened for two stone contracts, and on November 20, 1890, proposals were opened for one dredging contract.

One stone contract covered work that could be executed as heretofore, by rolling off rock by hand from common lighters, the other required the use of steam hoisting machinery, as the pile was to be brought originally up to high-water level, with as narrow a crest as possible. By this method of work the pile eventually assumes, under the action of the waves, as steep side slopes as possible, and as long as it remains high additional contraction of the water way over the jetty is secured. Very advantageous prices were obtained for both stone contracts, $1.90 a ton, in place, under the hand contract; $2.15 a ton, in place, under the hoister contract. These bids were accepted, and contracts for 50,000 tons, at $1.90, and 60,000 tons, at $2.15 a ton, were entered into on December 2, 1890, with Jacob Friday, who was the lowest bidder on both kinds of work. No bid for dredging was received.

The new stone plant belonging to the United States began work in September, 1890, that being the earliest date at which the railroad could be induced to put in a siding to the United States quarry at Edgefield. Since that time the plant has been kept at work, almost all rock having been deposited by steam hoisting from a floating derrick scow. The plant has at no time been worked to more than about one-third of its capacity, as the amount of money not covered by existing contracts was so small as to make it advisable to limit its operations to the lowest rate consistent with reasonable economy. The failure of the B. C. Howell contract for dredging, and the fact that the Friday contracts have not attained the required rate of progress, has made it advisable to increase the output by hired labor, and during the coming year the plant will be worked as nearly up to its capacity as is consistent with its continuous employment till other funds are available. This plant has already nearly paid for itself. Having it on hand and at work at the time contracts were advertised, enabled the United States to obtain the lowest prices yet offered for this improvement, although the work was more difficult than ever before. It also makes it possible to keep the rate of progress much more perfectly under control, as the output of rock can be increased at any time the contractors may fall behind in their work. The experience of 9 months shows that, even at the very small rate at which this plant has been worked, the cost per ton of rock in place is about the same as present contract prices. A large proportion of the expenses would not be increased by handling twice or three times the quantity of rock, and with more money available great economy could thus be secured, as well as an increased rate of progress.

The stone used is a hard, heavy, and compact gray granite, the pieces varying in size from about 20 pounds up to 7 tons. A large proportion has been of the larger sizes, the smaller pieces being used only to keep the quarry clear.

Experience with contract dredging at this locality has been so unsatisfactory that permission was asked and obtained to build a pump dredge to be operated by hired labor. At the close of the year this dredge was completed.

On the 23d of June she made her trial trip, proceeding for that purpose, to Sandy Hook Bay. Her average speed, running light, was about 10 miles an hour. She was tested for dredging, both in sand and mud, and threw a very heavy proportion of both characters of material without choking her pump or suction.

The dredge was built by Mr. Henry Lawrence, of Greenpoint, N. Y., from designs of Dr. L. A. Smith, of the Continental Iron Works, Greenpoint, N. Y., to whose skill and careful supervision the perfectly satisfactory working of the dredge is largely due.

The pumping machinery and boiler was supplied by Mr. B. C. Howell.

The whole construction of the dredge was inspected by Capt. E. O. Patterson, who will command the boat. He has attended to his duties in a most thorough and judicious manner.

The boat sailed for Charleston, S. C., on the 30th day of June.

No material changes have occurred in the condition of either jetty during the year except such as are due to work in that period.

The annual survey has shown marked deepening over the entire area between the jetties, especially at the inner part, where the deeper water has uniformly advanced seaward. On the crest of the bar the deepening is also marked, and a 12-foot channel now exists nearly all the way through. It is, however, as yet too narrow to admit of safe use by commerce. This is especially true, as changes are going on at such a rapid rate at present that new temporary lumps are likely to form at any time or place from the material in motion. Jim Evans Shoal has been pushed outward very rapidly, and now has but an insignificant area, with less than 9 feet on it. In front of the jetty opening the eroded material has pushed the 15 and 18 foot curves seaward somewhat, but the quantity of material deposited here is much less than that removed from between the jetties. Outside of the jetties, both to the north of the North Jetty and to the south of the South Jetty there is considerable shoaling, and this may account for some of the excess of scour over fill in the channel itself. The changes in the jetty channel since 1884 are well shown by the comparative charts published herewith.

For details of work done, and a discussion of the surveys, reference is made to the report of my assistant engineer, Mr. James P. Allen, who has assisted me most efficiently, both in the field and in the office.

The river and harbor act approved September 19, 1890, contains the proviso that $5,000 of the Charleston Harbor appropriation should be spent on the Mount Pleasant shore, which has been slowly cutting away for many years. Up to the close of the fiscal year no work had been done, as the right of way for the breakwater to protect this shore had not, up to that time, been approved by the Department of Justice.

APPROPRIATIONS.

In the thirteen years which have elapsed since the first appropriation was made, funds have been provided at an average rate of $169,423 per year, or less than 4 per cent. of the amount of the least revised estimate. It is evident that rapid completion of the work, proper economy in carrying it out, and early benefit therefrom can not be looked for with a system of insufficient appropriations. I most emphatically repeat the recommendation which has been made in each annual report for this work, that annual appropriations of from $500,000 to $750,000 be made with a view to speedily and economically completing this important improvement.

With the balance of $308,052.39 on hand on July 1, 1891, work will continue under both of the Friday contracts; dredging and stonework by hired labor and plant owned by the United States will continue at such rates as to admit of continuous work till such time as further funds are provided. A breakwater will be put along the Mount Pleasant shore, for such distance as the $5,000 will allow.

This work is in the collection district of Charleston, S. C., which is the port of entry. Amount of duties collected in calendar year 1890, $18,356.81.

Since the existing project of improvement has been adoped the following appropriations have been made:

By act of Congress approved—	
June 18, 1878	$200,000
March 3, 1879	200,000
June 14, 1880	170,000
March 3, 1881	175,000
By act of Congress passed August 2, 1882	300,000
By act of Congress approved—	
July 5, 1884	250,000
August 5, 1886	187,500
By act of Congress—	
Of August 11, 1888	350,000
Approved September 19, 1890	370,000
Total	2,202,500

Total expenditures to June 30, 1891, $1,894,447.61, which includes the cost of building shore protections on Sullivans Island and Mount Pleasant.

The following drawings and papers accompany this report:

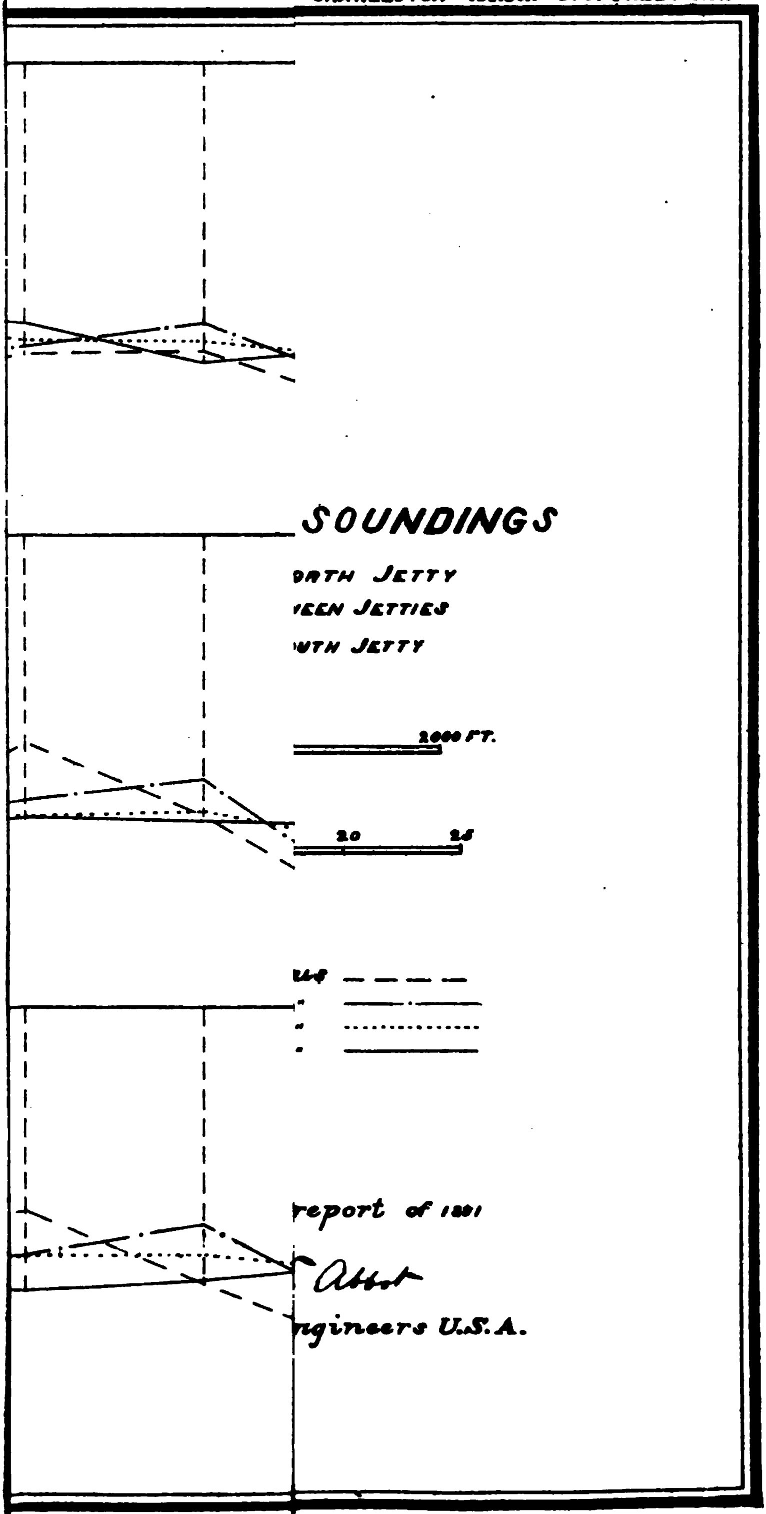
Sheet 1. Map showing survey of May, 1891.
Sheet 2. Longitudinal profiles through Jetty Channel, constructed from mean soundings.
Sheet 3. Comparison of surveys of 1884 and 1891.
Report of Mr. James P. Allen, assistant engineer.
Table of commercial statistics furnished by the collector of the port.
Statistical letter received from Mr. Edward Willis.

Money statement.

July 1, 1890, balance unexpended		$233,909.32
Amount appropriated by act approved September 19, 1890		370,000.00
		603,909.32
June 30, 1891, amount expended during the fiscal year		295,847.93
July 1, 1891, balance unexpended		308,052.39
July 1, 1891, outstanding liabilities	$34,987.12	
July 1, 1891, amount covered by uncompleted contracts	231,937.67	
		266,924.79
July 1, 1891, balance available		41,127.60
Amount (estimated) required for completion of existing project		2,178,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		750,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

En

CHARLESTON HARBOR. S.C. SHEET No. 2



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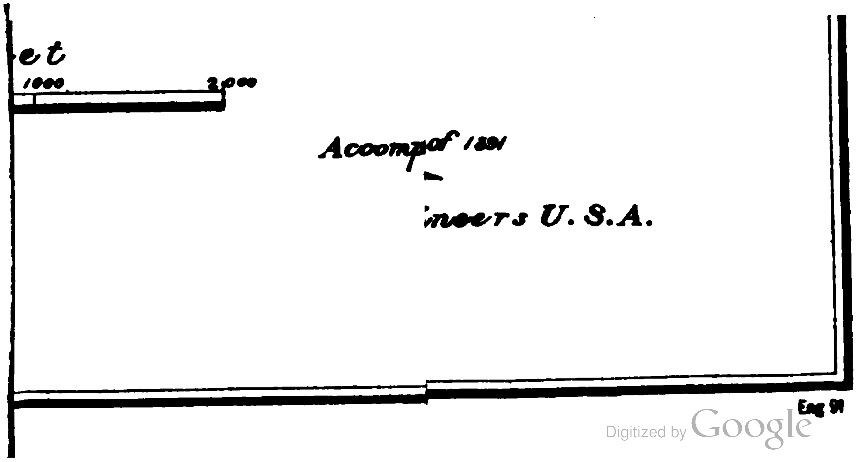

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Abstract of proposals for furnishing and depositing 50,000 tons of riprap stone on South Jetty, Charleston Harbor, South Carolina.

[Opened November 18, 1890.]

No.	Name of bidder.	On South Jetty inside Main Ship Channel.	Price per ton.	In Main Ship Channel.	Price per ton.	On outer portion.	Price per ton.	Aggregate.
		Tons.		*Tons.*		*Tons.*		
1	Roderick G. Ross	20,000	$2.24	15,000	$2.24	15,000	$2.24	$112,000
2	Jacob Friday	20,000	1.90	15,000	1.90	15,000	1.90	95,000
3	Grant & Egan	20,000	2.00	15,000	2.00	15,000	2.33	104,950

Date of commencing work and monthly progress, as required by specifications. Contract awarded to Jacob Friday at the prices stated.

Abstract of proposals for furnishing and depositing 60,000 tons of riprap stone on the jetties, Charleston Harbor, South Carolina.

[Opened November 18, 1890.]

No.	Name of bidder.	On the jetties.	Price per ton.	Aggregate.
		Tons.		
1	Roderick G. Ross	60,000	$2.29	$137,400
2	Grant & Egan	60,000	2.71	162,600
3	Jacob Friday	60,000	2.15	129,000

Date of commencing work and monthly progress, as required by specifications. Contract awarded to Jacob Friday at the price stated.

REPORT OF MR. JAMES P. ALLEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following annual report for Charleston Harbor for fiscal year ending June 30, 1891:

Work under the contract of Grant & Egan was continued. Twenty-four thousand eight hundred and seventy-three tons of stone was placed on the South Jetty, between 7,250 and 14,000 feet from the shore end, bringing this up to about low water with a width of probably 10 feet at mean low water. Thirteen thousand five hundred and forty-one tons of stone was deposited in the Main Ship Channel, being so distributed as to give a wide base for future work. It was deposited between 5,930 and 6,700 feet from the shore end. This was much less than was intended, but the stone was large, and it was found impossible to keep a smooth crest, and as this was the channel in constant use, the piling up of large stone would have been dangerous to navigation. In consequence, this work was discontinued, and more stone was put between 7,250 and 12,950 feet from the shore end than was at first intended to be used under the Grant & Egan contract. It was deposited so as to reënforce work already done by them. The stone so put in has been included in that above given as between 7,250 feet and 14,000. It was deposited a little to the southward of the center line of the jetty. About 1,100 feet of that portion of the South Jetty nearest Morris Island was raised and reënforced, and an extension built from the shore end westward, called the "western extension," which is 317 feet long and about 20 feet wide, consisting of stone alone. Four thousand eight hundred and fifty tons of stone were used in this place.

The contract of Grant & Egan was completed February 12, 1891.

The stone work to be done at Charleston Harbor with the appropriation of September 19, 1890, was subdivided into two portions, designed to be executed under separate contracts. One contract covered work that could be done by hand, rolling or throwing rock from lighters as heretofore, and the other required hoisters. Both of these contracts were awarded to Mr. Jacob Friday, of Pittsburg, Pa., who began work on his hand contract February 18, 1891, at 7,200 feet from the shore end of the South Jetty. After depositing 219 tons of stone at this place, he was moved to the outer end. Work under the hoister contract was begun on the North Jetty about 8,100 feet from the shore end on April 3, 1891. Under the hand contract 6,066 tons of stone of large sizes have been placed upon the South Jetty, between 15,225 and 16,400 feet from the shore end. This is being brought up to about mean low-water, with a crest width of 25 feet. About 6,211 tons of small stone have been spread over the jetty, and the 60 feet south of it, from 3,395 to 4,080 feet from the shore end, in order to reënforce this portion of the jetty where the covering of the original mattresses was rather light. The jetty was rather narrow here in view of the probable overflow that will result from the closing of the main ship channel. On the old jetty the covering is calculated to be about 1 foot thick, and on the 60 feet south, 2 feet thick. Under the hoister contract 9,213 tons of stone have been placed on the North Jetty from 8,100 feet to 9,150 feet from the shore end. With the amount available under the act of September 19, 1890, a new dredge, to be called "Charleston," has been built in Brooklyn. She is 122 feet and 6 inches long, 30 feet beam, and 12 feet depth of hold. She is furnished with a steeple, compound, Sullivan propelling engine, with cylinders 17 and 32 inches in diameter, and 22 inches stroke. She has one propeller wheel 7 feet 1 inch in diameter. Her pumping machinery is of the B. C. Howell pattern, and consists of a 230 H. P. compound condensing reciprocity engine and centrifugal pump, with a 15-inch discharge pipe and 14½-inch suction. Her carrying capacity is estimated at 225 cubic yards. She carries a crew of 16 men.

During the last fiscal year a plant was purchased by you for the United States, as reported in the annual report for 1890. In addition to this there is now in process of construction another hoister lighter about 80 feet by 30½ feet deck measurement and 8 feet deep, which is very strongly constructed, and for which the machinery is on the ground. She should be ready for work in about 2 months.

The Government is also operating a quarry near the town of Edgefield, S. C., which is expected to turn ont soon from 200 to 300 tons of stone per day. With the United States plant and stone from the quarries at and near Edgefield, the north jetty has been brought up to high water with a narrow crest line from 6,745 to 8,100 feet from the shore end.

It is not expected that this will remain as high as it is at present. In fact that portion of it first put in has lost height already, due mainly to the action of the waves.

The total quantity of stone quarried by the United States at the quarries in and near the town of Edgefield is 16,688 tons. The total quantity deposited on the jetties by the United States is 16,287 tons, of which 968 tons were purchased from Jacob Friday.

Dredging was continued under the contract with Mr. B. C. Howell, with the dredge boat *Frolic*, whose arrival on June 17, 1890, was noted in the last annual report. She continued working until November 8, 1890, removing 47,626 cubic yards of material. During this time the contractor sent to Charleston a tug boat, which had been chartered or purchased by him for the purpose, to tow the dredge. This boat did fairly well, although too small. On November 3, 1890, the whole of Mr. Howell's plant was attached for debt, and the dredge laid up on the 8th. No work has been done since, and he has not yet been able to overcome his financial difficulties.

Two tide gauges were kept in the swash channel, near the dredge cut. These were intended for the use of the dredge. The inspector obtained a considerable number of good readings of these gauges, which will be compared with the self-registering gauge at Fort Sumter. Some light will be thrown in this way upon the question of the range of the tides in swash channel, their periods, etc. The notes have been partially worked up during the winter months.

SURVEYS AND CROSS SECTIONS.

The cross sections begun during the last fiscal year were continued, being made somewhat more extended in order to show not only the shape of the rock pile, but also the scour near the jetties. Twenty-six of these were taken over the south jetties, covering most of this jetty, excepting the outer end. The slopes of the new rock, which was piled, as nearly as possible, on the center range, are shown to be quite steep in places. This was expected, and it is also anticipated that there will be some loss of height on account of the movement of the rock by wave action. Since these cross-sections were made, however, some more rock has been placed seaward of the center line thus widening the crest and increasing the stability of the existing pile.

It is considered most economical to raise the jetty from time to time on the center line, making a narrow crest, in order that the rock may assume the steepest slope possible, under the action of the sea. Comparing these cross sections with those taken in 1886 no marked changes are shown where no new work has been done, and no additional scour is indicated near the base of the jetty. The general cross section is shown to be quite stable in form. There seems to be but little danger of settlement on account of overpour in the immediate future. On the North Jetty 12 cross-sections were taken confined to the inner 6,500 feet of the jetty.

These show filling in some parts near the inner end, but generally considerable scour is shown and a decided trench has formed, mainly on the east side of the jetty.

SWASH CHANNEL.

The survey of the swash channel, shown on the charts submitted herewith, was made in May, 1891. For this survey the mean soundings have been calculated, and profiles platted, as in the last few years. Considerable scour is shown in the area between the jetties, and some seaward movement of the outer curves. The inner curves have moved outward to a marked extent. Material removed from between the jetties, as indicated by mean soundings, considerably exceeds the accretion just seaward of the ends of the jetties. Some of this excess may be attributed to the removal of material by dredging. Moreover the areas to the northeast and southwest of the jetties over which soundings were taken are shown by mean soundings to be somewhat shoaler than last year. This may be an indication that some of the sand moved from the channel finds its way behind the jetties.

A 12-foot channel, tolerably straight and practically along the dredged cut, is shown nearly through, there being only about 500 feet where the depths are less than 12 feet.

OTHER SURVEYS.

No other surveys have been made during the fiscal year.

CONDITION OF THE JETTIES.

No settlement or deterioration of the jetties of sufficient importance to be noticed has occurred during the year.

SULLIVAN ISLAND.

No survey of the beach was made, as it is known that no change of importance has taken place.

MORRIS ISLAND.

The head of Morris Island was surveyed in April, 1891. Both the high-water and low-water lines have moved slightly seaward near the jetty. To the south of the jetty the change is not great. From 300 feet north to the head of the island the high-water line has moved inward, the maximum being 100 feet near the head, while the low-water line from 500 feet north of the jetty has moved inward also, but not so decidedly as the other.

MOUNT PLEASANT SHORE.

Steps have been taken to secure the necessary right of way for a breakwater to be built in accordance with the provision of the act of September 19, 1890. No changes worthy of especial note in this report are known to have occurred.

SUPERINTENDENT AND INSPECTORS.

Mr. W. L. Mikell was charged with the superintendence of both the hired labor and the contract work, until his death on January 29, 1891. Mr. Mikell was a faithful, judicious, and thoroughly interested superintendent, and his sickness and death were a severe blow to the work and shock to his associates. He was assisted, until his death, by his brother, Mr. J. E. Mikell, and Mr. W. D. Gallaird. These two gentlemen have, since his death, had charge, the first of all the contract work for depositing stone, and the second of the hired-labor work, and United States plant. Both have been active and faithful in the discharge of their duties. Col. F. L. Childs inspected the dredging during the continuance of work, with his usual zeal and efficiency.

Very respectfully, your obedient servant,

JAMES P. ALLEN,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels and commerce at Charleston, S. C., from January 1, 1875, to December 31, 1890.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1875	504	382, 018	11, 949	38	13, 144	326	198	88, 879	2, 404	740	484, 041	14, 379
1876	471	340, 439	10, 113	44	11, 898	335	224	101, 272	2, 768	739	453, 609	13, 216
1877	400	324, 919	9, 885	32	13, 972	808	336	105, 480	2, 851	668	444, 371	13, 044
1878	396	322, 527	9, 623	44	19, 935	455	329	163, 368	3, 967	772	505, 830	14, 045
1879	383	326, 681	10, 027	39	12, 505	319	249	121, 503	3, 292	668	460, 659	13, 638
1880	441	388, 026	20, 641	38	12, 412	327	191	110, 771	2, 595	670	511, 209	13, 563
1881	412	399, 732	10, 377	34	9, 430	272	257	121, 077	3, 073	703	530, 239	13, 722
1882	410	384, 690	9, 446	35	4, 807	224	200	105, 647	2, 648	645	495, 144	12, 318
1883	345	277, 538	7, 629	26	3, 002	157	239	113, 768	2, 958	610	394, 308	10, 744
1884	425	304, 382	9, 822	21	3, 910	145	214	134, 076	3, 269	690	442, 368	13, 236
1885	375	268, 477	9, 637	15	2, 344	97	187	106, 233	2, 586	577	377, 054	12, 320
1886	901	550, 209	....	20	3, 714	131	182	114, 507	2, 646	1, 103	668, 403	....
1887	927	656, 949	....	30	7, 074	199	127	67, 257	1, 607	1, 084	731, 280	....
1888	*924	601, 771	....	34	7, 750	252	127	72, 921	1, 779	1, 085	682, 442	....
1889	†330	481, 718	9, 708	30	6, 985	216	136	87, 101	1, 979	496	575, 804	11, 903
1890	‡410	600, 776	13, 677	35	7, 205	242	120	81, 518	1, 828	565	689, 499	15, 745

* Of these, 32 vessels (tonnage, 31,035), with crews numbering 608, were foreign.
† Of these, 29 vessels (tonnage, 9,440), with crews numbering 546, were foreign.
‡ Of these, 58 vessels (tonnage, 55,533), with crews numbering 1,110, were foreign.

CLEARED.

1875	461	328, 266	10, 830	57	24, 679	555	211	94, 595	2, 527	729	447, 540	13, 912
1876	431	278, 744	9, 095	60	23, 598	546	230	103, 276	2, 812	721	405, 618	12, 453
1877	335	234, 429	7, 719	35	22, 767	423	250	108, 446	2, 910	620	365, 662	11, 052
1878	266	172, 988	5, 801	45	24, 397	479	398	149, 975	3, 591	509	347, 360	14, 045
1879	287	188, 212	6, 268	34	11, 282	292	278	149, 052	3, 643	599	348, 546	10, 203
1880	296	190, 733	6, 348	45	23, 210	481	246	155, 768	3, 375	587	369, 711	10, 204
1881	268	187. 569	5, 942	32	9, 239	255	278	153, 796	3, 464	578	350, 604	9, 661
1882	147	113, 699	3, 690	40	7, 375	273	263	158, 250	3, 584	450	379, 324	7, 546
1883	98	48, 714	2, 018	27	4, 560	181	299	154, 653	3, 815	424	207, 927	6, 014
1884	212	116, 020	4, 555	31	7, 845	217	276	161, 588	3, 727	519	285, 453	8, 499
1885	191	99, 658	5, 047	24	5, 217	164	204	119, 602	2, 836	419	224, 467	8, 047
1886	890	543, 259	....	25	5, 469	165	201	126, 943	2, 875	1, 116	675, 671	....
1887	888	610, 646	....	28	5, 837	189	173	115, 218	2, 546	1, 089	731, 701	....
1888	*911	580, 468	....	30	5, 848	211	144	96, 146	2, 105	1, 085	682, 462	....
1889	†46	358, 596	778	25	5, 080	174	165	112, 037	2, 495	236	155, 713	3, 467
1890	‡21	12, 863	292	41	10, 161	318	166	126, 078	2, 676	228	149, 102	3, 236

* Of these, 7 vessels (tonnage, 4,295), with crews numbering 62, were foreign.
† Of these, 4 vessels (tonnage, 2,960), with crews numbering 47, were foreign.
‡ Of these, 7 vessels (tonnage, 6,186), with crews numbering 135, were foreign.

Commerce at Charleston, S. C.—Continued.

COMMERCE.

Year.	Value of exports.	Value of imports.	Duties collected.
1875	$19,655,966	$680,848	$80,656.00
1876	18,088,152	455,562	89,168.00
1877	16,917,492	161,287	46,848.00
1878	21,167,575	184,127	36,990.00
1879	18,698,126	127,981	24,070.00
1880	24,989,259	248,158	46,453.98
1881	21,927,269	723,049	99,066.23
1882	19,907,099	459,970	45,263.33
1883	20,144,865	467,648	48,760.69
1884	20,833,424	503,504	36,624.76
1885	15,157,889	588,191	32,741.68
1886	17,410,000	635,000	24,876.00
1887	15,288,316	484,063	30,817.00
1888	13,006,578	625,770	76,398.00
1889	16,080,255	664,696	16,728.82
1890	15,204,771	836,626	18,356.81

T. B. JOHNSTON,
Collector.

Trade of Charleston, S. C., from January 1 to December 31, 1890.

[By E. Willis.]

EXPORTS.

Articles.	Quantity.	Value.
	Tons.	
Upland cotton, from September 1 to May 4, 521,628 bales	128,876	$26,000,000
Sea Island cotton, 13,303 bags	2,300	1,330,000
Rice, 800,000 bushels	12,500	1,250,000
Rosin, 220,000 barrels	30,000	400,000
Turpentine, 50,000 casks	8,500	1,250,000
Phosphate rock, crude	320,000	2,500,000
Phosphate rock, ground	6,000	65,000
Fertilizers, 2,750,000 sacks	275,000	5,000,000
Lumber, timber, shingles, railroad ties, 75,000,000 feet	1,200,000	750,000
Cotton goods, domestic, and yarns, 62,500 bales	12,500	3,250,000
Cotton seed, seed-meal cake	3,000	50,000
Kaolin, 20,000 casks	20,000	360,000
Vegetables, 70,000 crates	4,000	180,000
Strawberries, 500,000 quarts	500	75,000
Potatoes, 80,000 barrels	8,500	350,000
Melons (State), 1,200 carloads	50,000	250,000
Miscellaneous	100,000	75,000
Total	2,077,676	43,135,000

IMPORTS.

Bacon, 60,000,000 pounds	30,000	$3,600,000
Flour, 180,000 barrels	18,000	1,000,000
Corn, 800,000 bushels	25,000	600,000
Hay, 50,000 bales	5,600	100,000
Oats, 160,000 bushels	2,500	70,000
Grist and meal, 100,000 barrels	10,000	280,000
Sugar, 100,000 barrels	15,000	1,500,000
Molasses, 5,000 barrels	1,000	100,000
Salt, 12,500 sacks	1,250	7,000
Cotton bagging, Sea Island, 50,000 yards	50	7,500
Bagging and burlaps, 4,000,000 yards	2,000	250,000
Jute butts, 30,000 rolls	6,000	250,000
Petroleum and other oils, 35,000 barrels	6,000	300,000
Ice	30,000	70,000
Cigars, 17,500,000; tobacco, 1,900,000 pounds	2,500	1,100,000
Paper and stationery and book-binding	1,000	300,000
Groceries and dry goods	100,000	25,000,000
Hardware	70,000	2,000,000

Trade of Charleston, S. C., from January 1 to December 31, 1890—Continued.

IMPORTS—Continued.

Articles.		Quantity.	Value.
		Tons.	
Boots and shoes		10,000	$1,250,000
Crockery		5,000	200,000
Drugs and medicines		2,500	600,000
Granite	450,000 blocks	7,500	160,000
Rubble		65,000	
Marble		175	
Brownstone		400	
Curbing		200	
Paving		1,200	
Kainit		14,000	90,000
Brimstone		20,000	325,000
Nitrate of soda		3,200	100.000
Muriate of potash		2,800	90,000
Lime, cement, plaster		10,000	25,000
Manufactures		25,000	7,500,000
Total		492,875	46,874,500

M 11.

IMPROVEMENT OF ASHLEY RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination see Appendix S 8, Annual Report for 1873.

ORIGINAL CONDITION.

The river was obstructed by two shoals, with not over 9 feet of water on them.

PLAN OF IMPROVEMENT.

A depth of from 10 to 11 feet was to be secured by dredging.

WORK PRIOR TO JUNE 30, 1890.

Twenty-two thousand one hundred and twenty-four cubic yards of material had been removed, and the desired depth had been obtained and maintained.

WORK OF PAST YEAR.

No work was done. With the approval of the Department the balance ($826.34) on hand is held for the present to be expended when necessary in dredging at any point on the river which may shoal to a less depth at low water than 10 or 11 feet.

REMARKS.

No new transportation lines have been established on this river during the year. The improved reaches are in satisfactory condition. The new bridge near Charleston has been changed by its owners so that its draw-span is now correctly located and fendered. Appended to this report is a statement prepared by Mr. E. Willis, of Charleston, giving the required freight statistics. During the year the freight passing over this stream has aggregated 331,200 tons.

This river is tributary to the collection district of Charleston, S. C. Charleston is its port of entry. Amount of duties collected in the calendar year of 1890, $18,356.81.

For this improvement the following appropriations have been made:

By act of Congress approved—	
June 14, 1880	$1,000
March 3, 1881	1,500
July 5, 1884	2,000
August 5, 1886	1,000
Total	5,500

Total expenditures to June 30, 1891, $4,673.66.

The following papers accompany this report:

Statistical letter of Mr. Edward Willis, of Charleston, S. C.

Money statement.

July 1, 1890, balance unexpended	$846.00
June 30, 1891, amount expended during fiscal year	19.66
July 1, 1891, balance unexpended	826.34

Commerce of Ashley River, South Carolina.

[Furnished by Mr. E. Willis.]

Articles.	1888.	1889.	1890.
Phosphate rock	$1,045,000	$1,200,000	$1,600,000
Sulphur, kainit, blood, potash, cotton-seed meal, tankage, etc	750,000	800,000	900,000
Timber, lumber, shingles, cross-ties, hoop poles	30,000	35,000	40,000
Miscellaneous	25,000	30,000	40,000
	1,850,000	2,065,000	2,580,000

E. WILLIS.

CHARLESTON, S. C., *May 8, 1891.*

M 12.

IMPROVEMENT OF WAPPOO CUT, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For original project see page 1073, Annual Report for 1881. For modified project see page 1196, Annual Report for 1889.

ORIGINAL CONDITION.

Wappoo Cut was a narrow, crooked tidal stream, with but little depth, connecting Ashley and Stono rivers.

PLAN OF IMPROVEMENT.

The project provides for securing a sufficiently straight and continuus channel 60 feet wide between low-water lines and 6 feet deep at low water from Ashley to Stono rivers. The bulk of the work is dredging. To maintain the channel two training walls at Stono entrance and three closing dams are to be made and some bank protection done. The estimated cost is $88,000.

WORK PRIOR TO JUNE 30, 1890.

One hundred and thirty-seven thousand one hundred and ninety-five cubic yards of dredging had been done. A number of snags, stumps, and overhanging trees had been removed, and a bulkhead had been built across the mouth of Pompey Cut. The south side of Elliott Cut had been revetted with stone for a length of 1,300 feet.

WORK OF PAST YEAR.

Elliott Cut has been snagged. A new cut just east of Elliott Cut has been completed. This work was done under contract with Mr. Thomas Young, of Charleston, S. C.

REMARKS.

No new transportation lines have been established through this cut during the year. Parties using the river report much benefit from the new cut made by the United States. The location of all work done on this improvement is shown on the accompanying map. For details ot work done reference is made to the report of my assistant engineer, Mr. James P. Allen, who has shown during the year his usual efficiency and skill. With the balance of $2,586.23 on hand July 1, 1891, a dam will be built across the old slough to the south of the new cut, and the banks of Elliott Cut will be revetted as far as the funds will allow in accordance with the revised project.

This work is in the collection district of Charletson, S. C., which is the port of entry. Amount of duties collected in the calendar year of 1890, $18,356.81.

The following appropriations have been made for this improvement:

By act of Congress—	
Approved March 3, 1881	$10,000
Passed August 2, 1882	10,000
Approved July 5, 1884	3,000
Approved August 5, 1886	5,000
Of August 11, 1888	5,000
Approved September 19, 1890	10,000
Total	43,000

Total expenditures to June 30, 1891, $40,413.77.

The following papers accompany this report:

Report of Mr. James P. Allen, assistant engineer.
Map of improved portion of Wappoo Cut.

Money statement.

July 1, 1890, balance unexpended	$1,646.00
Amount appropriated by act approved September 19, 1890	10,000.00
	11,646.00
June 30, 1891, amount expended during fiscal year	9,059.77
July 1, 1891, balance unexpended	2,586.23
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

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Abstract of proposals for dredging in Wappoo Cut, South Carolina, opened November 21, 1890.

No.	Name of bidder.	Quantities.	Price dredged and dumped.
		Cu. yds.	*Per cu. yd.*
1	P. Sanford Ross	40,000	$0.25
2	Thomas Young	40,000	.24

Date of commencing work and monthly progress as required by specifications. Contract awarded to Thomas Young, of Charleston, S. C., at the price stated.

REPORT OF MR. JAMES P. ALLEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following annual report for Wappoo Cut, South Carolina.

Between October 7 and October 15, 1890, 4 trees were cut and 8 cords of brush, 4 logs and 13 stumps were removed, mainly from the north bank of Elliott's Cut, the hoister belonging to Charleston Harbor, South Carolina, being used for the purpose at the time when she could be spared from work on the jetties.

This work was done under the supervision of Mr. W. L. Mikell. The brush, logs, and stumps removed were put across an arm to the north, which was to have been closed, thus forming a partial dam that may serve every practical purpose. The removal of the above obstructions was effected at a cost of about $8 each, which is not large when the smallness of their number is considered. These obstructions had seriously annoyed vessels using the cut, and complaint had been made by those interested.

On January 6, 1891, work of dredging was begun under the contract of Mr. Thomas Young. This was continued with some interruptions until May 5, 1891, at which time it was completed. The total number of cubic yards removed was 33,514. The work was limited to making a new cut through the marsh from Pompey Cut eastward, and deepening the two entrances of this cut.

The contract price for this dredging was 24 cents per cubic yard. The total cost of the work for the fiscal year was about $9,000.

The dredging was inspected by Mr. Arthur Pinckney, who has been faithful in attendance upon his duties.

A very thorough stadia survey of the improved portion was made in April and May, 1891, covering the part dredged. A copy of the map is herewith submitted. A good channel over 6 feet in depth is shown throughout, using the New Marsh Cut, except just west of the Marsh Cut of 1883, where there is an evident tendency to shoaling.

Very respectfully, your obedient servant,

JAMES P. ALLEN,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS OF WAPPOO CUT, SOUTH CAROLINA.

	1888.		1889.		1890.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Phosphate rock........tons..	60,000	$300,000	75,000	$450,000	70,000	$475,000
Sea Island cotton.....bags..	6,000	360,000	5,500	340,000	10,000	750,000
Rice..............bushels..	150,000	150,000	155,000	155,000	250,000	262,500
Vegetables.........crates..	120,000	240,000	110,000	220,000	80,000	125,000
Fertilizers............tons..	2,000	30,000	3,000	45,000	2,500	40,000
Lumber and timber...feet..	20,000,000	160,000	25,000,000	200,000	22,500,000	190,000
Shingles and other articles	....	....	....	20,000	....	25,000
Total, tons and value..	190,000	1,240,000	220,000	1,410,000	240,000	1,867,500

E. WILLIS.

CHARLESTON, S. C., *May 8, 1891.*

M 13.

IMPROVEMENT OF EDISTO RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 1140, Annual Report for 1881.
For modified project, see page 1168, Annual Report for 1889.

ORIGINAL CONDITION.

The river was choked with snags and had many half-formed natural cut-offs.

PLAN OF IMPROVEMENT.

The project provides for snagging, etc., to give easy navigation for rafts and flat-boats from Guignard's Landing to the mouth of the river, a distance of about 260 miles, at an estimated cost of $33,385.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points 227 miles and no miles above the mouth, 23,226 logs, snags, and overhanging trees, etc., having been removed from the channel and banks. Numerous outlets into the swamps had been closed, and one large natural cut-off had been opened and made the main channel of the river.

WORK OF PAST YEAR.

The river and harbor act of September 19, 1890, in providing for this improvement, contains a requirement that the money appropriated should be spent in equal portions in the North and South Forks. In accordance therewith work was commenced near Orangeburg on the North Fork and at Holman's Bridge on the South Fork, and no work was done on the main river below the "forks." The original project did not provide for any work on the North Fork of the Edisto River, and, therefore, the $2,500 provided for such work should not be charged against the original estimated cost of this improvement.

The North Fork was roughly cleared for raft navigation by plant owned and operated by the United States for width of 60 feet and depth of 18 inches at low water, between Orangeburg Bridge and 8 miles below.

The South Fork was quite thoroughly cleared by plant owned and operated by the United States for width of 60 feet and depth of 18 inches at low water, between Holman's Bridge and New Bridge.

The average cost of removing obstructions was about 66 cents each. For details of work done and commercial statistics, reference is made to the report of my assistant engineer, Mr. James P. Allen, who has shown his usual zeal and ability.

REMARKS.

No new transportation lines have been established on this river during the year. With the balance of $4,193.25 on hand July 1, 1891, snagging will be continued on both forks, the worst obstructions being removed first.

During the year the freight passing over this stream has aggregated 126,080 tons.

This river is tributary to the collection district of Charleston, S. C. Charleston on the north and Beaufort on the south are the nearest ports of entry. Duties on imports collected in the calendar year 1890, at the custom-house at Charleston, $18,356.81; at Beaufort, S. C., nothing.

For this improvement the following appropriations have been made:

By act of Congress—	
Passed August 2, 1882	$8,000
Approved July 5, 1884	5,000
Approved August 5, 1886	3,000
Of August 11, 1888	5,000
Approved September 19, 1890	5,000
Total	26,000

Total expenditures, including June 30, 1891, $21,806.75.

The following paper accompanies this report:

Report of Mr. James P. Allen, assistant engineer.

For table of commercial statistics, furnished by the collector of Charleston, S. C., see this year's annual report for Charleston Harbor. For table of commercial statistics furnished by the collector of Beaufort, S. C., see this year's annual report for Salkahatchie River.

Money statement.

July 1, 1890, balance unexpended	$336.50
Amount appropriated by act approved September 19, 1890	5,000.00
	5,336.50
June 30, 1891, amount expended during fiscal year	1,143.25
July 1, 1891, balance unexpended	4,193.25
July 1, 1891, outstanding liabilities	1,014.63
July 1, 1891, balance available	3,178.62
Amount (estimated) required for completion of existing project	7,385.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,385.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. JAMES P. ALLEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following annual report for Edisto River, South Carolina:

In July, 1890, 35 stumps were removed at Taff Rumph Suck, completing the improvement at this point at least for the present. These stumps were removed by the use of dynamite at a cost of $4.52 each. These stumps were all at some distance from the shore and were in a very strong current. Nothing was done on this river between July, 1890, and May, 1891. Work was deferred in order to secure as long a period of low water as possible. On May 15 operations began at Holman's Bridge, on the South Fork, and at Orangeburg Bridge, on the North Fork, in accordance with the provisions of the last river and harbor act, which make it obligatory that an equal amount be spent on each of these.

Contrary to expectations the season proved to be wet, and the party on the North Fork had to suspend operations on May 29.

Work was resumed on this fork on June 17.

The following work has been done on this fork: Five hundred and eleven trees and 92½ cords of brush were cut from the banks, and 314 logs, 128 stumps, 224 large snags, and 17½ cords of small snags were removed from the channel covering 8 miles in length of river between Orangeburg and the junction of the North and South Forks. The channel which it is designed to secure will be 60 feet wide and 18 inches deep at low water. The average cost of obstructions removed was 66 cents.

On the South Fork 485 trees and 155 cords of brush were cut from the banks, and 325 logs, 345 stumps, 628 large snags, and 47 cords of small snags were removed from the channel, which will be 60 feet wide and 18 inches deep at low water. Two sucks were barricaded. The average cost of obstructions removed, 60 cents. The barricades cost $5 each. This work was done between Holman Bridge and the new bridge.

Inclosed is a statement of the business of the whole river, which has been prepared by Mr. J. D. Ackerman. There is some traffic passing down the North Fork as far as Orangeburg, S. C., where it is shipped by rail. This does not show on the statement, as complete statistics could not be obtained.

Mr. J. D. Ackerman has superintended the work on the North Fork, and Mr. B. G. Willis that on the South Fork. They have both been active and efficient in the discharge of their duty.

Very respectfully, your obedient servant,

JAMES P. ALLEN,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

ORANGEBURG, S. C., *June 1, 1891.*

I beg leave herewith to send you the following report of commerce on the Edisto River for the year 1890:

Sawed lumber, 35,000,000 feet, B. M.	$280,000.00
Hewn timber, 17,000,000 feet	102,000.00
Round timber, 1,500,000 linear feet	75,000.00
Cross ties, 2,500,000 feet	200,000.00
Cord wood	8,000.00
Rice, 128,796 bushels	154,555.20
Naval stores, 900 barrels	3,600.00
	823,155.20

Tonnage, 126,080 tons, including 124,000 tons of timber, etc.

Respectfully submitted.

Your obedient servant,

J. D. ACKERMAN.

Capt. F. V. ABBOT, U. S. A.

M 14.

IMPROVEMENT OF SALKAHATCHIE RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination, see page 1144, Annual Report for 1881.

ORIGINAL CONDITION.

The river was choked with logs and snags, and in some places was divided into small branches by numerous low-lying islands.

PLAN OF IMPROVEMENT.

The project provides for clearing the channel for rafts and flat-boats from a point 5 miles above Toby's Bluff to Hickory Hill, 46 miles above the river mouth, a total length of 77 miles, at an estimated cost of $18,000.

WORK PRIOR TO JUNE 30, 1890.

The river had been snagged between points 46 miles and 123 miles above the mouth, 12,631 logs, snags, overhanging trees, etc., having been removed from the channel and banks. Over 171 outlets into the swamp were closed; a dam was built to remove a local shoal; one natural cutoff was widened and made the main channel of the river, and one bad cutoff was closed.

WORK OF PAST YEAR.

The river was quite thoroughly snagged by plant owned and operated by the United States for a width of 20 feet and depth of 18 inches at low water, between points 4 miles above Toby Bluff and the public landing below the Charleston and Savannah Railroad Bridge. Considerable other work was done on the river.

For details of work done and commercial statistics reference is made to the report of my assistant engineer, Mr. James P. Allen, who has shown his usual zeal and ability.

REMARKS.

No new transportation lines have been estalished on the river during the year. With the balance of $4,524.80 on hand July 1, 1891, snagging will be continued, the worst obstructions being removed first.

As the appropriation of September 19, 1890, completes the estimated cost for this improvement a considerable balance will be held in hand to maintain the river in a navigable condition in the future. During the year the freights passing over this stream have aggregated 13,000 tons.

This river is tributary to the collection district of Charleston, S. C. Beaufort is the nearest port of entry. Duties on imports collected at the custom-house at Beaufort, S. C., in 1890, nothing.

For this improvement the following appropriations have been made:

By act of Congress passed August 2, 1882	$5,000
Approved July 5, 1884	3,000
Approved August 5, 1886	2,000
Of August 11, 1888	3,000
Approved September 19, 1890	5,000
Total	18,000

Total expenditures, including June 30, 1891, $13,475.20.

The following papers accompany this report:

Report of Mr. James P. Allen, assistant engineer.
Table of commercial statistics furnished by the collector of Beaufort, S. C.

Money statement.

July 1, 1890, balance unexpended	$245.15
Amount appropriated by act approved September 19, 1890	5,000.00
	5,245.15
June 30, 1891, amount expended during fiscal year	720.35
July 1, 1891, balance unexpended	4,524.80
July 1, 1891, outstanding liabilities	5.60
July 1, 1891, balance available	4,519.20

REPORT OF MR. JAMES P. ALLEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following report for Salkahatchie River, South Carolina, during the fiscal year ending to-day:

Nothing was done upon this river until May 1, 1891, at which time operations began upon the lower portion. The work has been distributed between 4 miles above Toby's Bluff and the Charleston and Savannah Railroad Bridge. The following has been done: Sixty-six trees and 10¼ cords of brush were cut from the banks, and 33 logs, 28 stumps, 22 large snags and 3¼ cords of small snags were removed from the channel. Two outlets which had been previously stopped were repaired. Five stoppages had additional work done on them, three sand points were dug off, some work was done on the sand bar at Quinney's Landing, a new run was opened around a sand bar just below Toby's Bluff, some weeds were dug out to increase the depth of the channel.

The work on this river was practically extended over the whole of the improved portion, and consisted of removing newly fallen trees, and general repairs. It is difficult to give the exact cost of the removal of each obstruction. The total expenditures for the work was $725.75, which distributed among the total number would show an average cost of about $4.

The work has been superintended by Mr. W. D. Niles, overseer. He has done good and faithful work.

Very respectfully, your obedient servant,

JAMES P. ALLEN,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

SALKAHATCHIE RIVER, SOUTH CAROLINA, *June 8, 1891.*

DEAR SIR: I hereby comply with your request of April 17, 1891, and submit the following report of the commerce passing over the Salkahatchie River, South Carolina, for the year 1890. The rice herein reported was shipped over that part of the river known as Combahee:

Rice, 200,000 bushels	$250,000
Lumber, 3,000,000 feet, B. M	27,000
Spirits turpentine, 450 casks	8,100
Rosin, 4,500 barrels	6,750
General merchandise, etc	5,000
Total	296,850

The tonnage of the above is about 13,000 tons.

Yours respectfully,

W. D. NILES.

Capt. F. V. ABBOT,
Corps of Engineers, U. S. A.

Arrival and clearances of vessels and commerce at Beaufort, S. C., from January 1, 1888, to December 31, 1890.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1888....	103	121,207	2,630	3	1,093	26	30	21,785	422	136	144,085	3,078
1889....	98	128,834	2,728	2	1,461	19	58	54,464	1,096	158	230,193	3,853
1890....	43	49,173	927	7	2,987	75	52	48,656	972	102	100,816	1,974

CLEARED.

Year.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.	No.	Tons.	Crew.
1888....	57	63,287	1,566	3	1,465	33	78	85,523	1,561	138	150,275	3,160
1889....	57	73,744	1,872	....	....	....	98	99,898	1,944	155	173,642	3,816
1890....	12	6,436	127	1	101	14	88	94,285	1,828	101	100,822	1,969

Commerce.

Year.	Value of exports.	Value of imports.	Duties collected.
1888	$850, 393. 00	$65, 645, 86	$17. 00
1889	1, 083, 085, 00	24, 266. 00	160. 00
1890	1, 040, 197. 00	41, 005. 00	....

ROBERT SMALLS,
Collector.

M 15.

IMPROVEMENT OF BEAUFORT RIVER, SOUTH CAROLINA.

REFERENCE TO PAST REPORTS.

For preliminary examination see page 1235, Annual Report for 1890.

ORIGINAL CONDITION.

There was a thoroughly good 7-foot channel between the town of Beaufort and Coosaw River, except at a point called Brickyard, near Coosaw mouth. The least depth here was about 4 feet at low water, and the channel when deep enough was too narrow.

PLAN OF IMPROVEMENT.

It is proposed to deepen and widen the channel by dredging sufficiently to give a continuously wide 7-foot channel at low water all the way through. The estimated cost is $25,000.

WORK PRIOR TO JUNE 30, 1890.

No work had been done by the United States.

WORK OF PAST YEAR.

Dredging under contract with Mr. Thomas Young, of Charleston, S. C., began in the Coosaw mouth so near the close of the fiscal year that but little has as yet been done.

REMARKS.

No new transportation lines have been established on this river during the year.

With the balance of $11,896.83 on hand July 1, 1891, dredging will continue.

During the year the freight passing over this stream has aggregated about 325,000 tons.

This river is in the collection district of Beaufort, S. C. Beaufort is its port of entry. Amount of duties collected in the calendar year of 1890, $0.00.

For this improvement the following appropriations have been made:

By act of Congress approved September 19, 1890, $12,500.

Total expenditures including June 30, 1891, $603.17.

The following papers accompany this report:

Report of Mr. James P. Allen, assistant engineer.

For table of commercial statistics, furnished by the collector of Beaufort, S. C., see this year's annual report for Salkahatchie River, South Carolina.

Money statement.

Amount appropriated by act approved September 19, 1890		$12,500.00
June 30, 1891, amount expended during fiscal year		603.17
July 1, 1891, balance unexpended		11,896.83
July 1, 1891, outstanding liabilities	$863.42	
July 1, 1891, amount covered by uncompleted contracts	10,136.58	
		11,000.00
July 1, 1891, balance available		896.83
Amount (estimated) required for completion of existing project		12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		12,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Brickyard Creek, South Carolina, opened November 21, 1890.

No.	Name of bidder.	Quantity.	Price per cubic yard towed less than 1 mile.	Quantity.	Price per cubic yard towed more than 1 and less than 2 miles.	Price per cubic yard for rock.
1	P. Sanford Ross	30,000	$0.24	20,000	$0.26	$3.25
2	Thomas Young	30,000	.23	20,000	.25	3.00

Date of commencing work and monthly progress, as required by specifications. Contract awarded to Thomas Young, at the prices stated.

REPORT OF MR. JAMES P. ALLEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1891.

CAPTAIN: I have the honor to submit the following annual report for Beaufort River, South Carolina:

The contract for this work was awarded to Mr. Thomas Young, of Charleston, S. C., who was also the contractor for Wappoo Cut. He was allowed until July 1 to begin work at Brickyard in order to give him time to complete his Wappoo Cut contract. On April 13 I went to Brickyard Creek from Charleston and laid out the necessary ranges, setting tide gauges also. This opportunity was taken looking to the possibility of pressing engagements for myself when work actually began. I was efficiently assisted in this by Mr. L. L. Gaillard, who was sent to the locality when the dredge reported for work, to point out the ranges, dumping ground, etc. The contractor's plant left Charleston for Brickyard on June 5, 1891, arriving on the 9th. Actual work began on June 15, 1891; 3,754 cubic yards have been dredged just inside of the mouth of Brickyard Creek. The material has been dumped in Coosaw River about a quarter of a mile below the mouth of the creek. The work is being inspected by Mr. Arthur Pinckney.

Very respectfully, your obedient servant,

JAMES P. ALLEN,
Assistant Engineer.

Capt. FREDERIC V. ABBOT,
Corps of Engineers, U. S. A.

M 16.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

REFERENCE TO PAST REPORTS.

For description of wreck in process of removal at close of last fiscal year see page 1233, Annual Report for 1890.

The work was completed early in July, 1890. No bid was obtained for the old guns, which was all that was obtained from the wreck. With the exception of three guns these were deposited in accordance with authority from the Chief of Engineers upon the north jetty, Charleston Harbor.

In accordance with directions from the Secretary of War three of the guns were sold at a second auction, the price bid being $10.

The balance of the funds unexpended and the $10 received from the sale at auction of the three guns were turned into the United States Treasury, as required by law.

M 17.

PRELIMINARY EXAMINATION OF WATEREE RIVER, SOUTH CAROLINA, FROM CAMDEN TO THE FALLS OF THE CATAWBA, ALSO OF THE BEND OR CURVE IN SAID RIVER ABOUT FOUR MILES BELOW CAMDEN.

[Printed in House Ex. Doc. No. 271, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 18, 1891.

SIR: I have the honor to submit the accompanying copy of report, dated February 5, 1891, from Capt. F. V. Abbot, Corps of Engineers, giving results of preliminary examination of Wateree River, South Carolina, "from Camden to the falls of the Catawba, also of the bend or curve in said river about 4 miles below Camden between the plantations of Witte and Williams, to determine if it is advisable in the interest of navigation to make a cut-off across the neck of said bend," made to comply with provisions of the river and harbor act approved September 19, 1890.

Captain Abbot reports that in his opinion the interests of navigation do not demand that the cut-off mentioned be made and that the Wateree River above Camden is not worthy of improvement. Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, agrees that the portion of the river referred to is not worthy of improvement, and in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF CAPTAIN FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., February 5, 1891.

GENERAL: I have the honor to submit the following report of an examination made in accordance with the following clause of the river and harbor act of September 19, 1890:

SEC. 17. That the Secretary of War is hereby directed, at his discretion, to cause examinations or surveys, or both, to be made, and the estimated cost of improvement to be estimated, at the following localities, to wit:

* * * * * * *

SOUTH CAROLINA.

Wateree River from Camden to the falls of the Catawba, also of the bend or curve in said river about 4 miles below Camden between the plantations of Witte and Williams, to determine if it is advisable in the interest of navigation to make a cut-off across the neck of said bend.

* * * * * * *

The portion of the Wateree River above Camden was examined in 1879 by Mr. J. M. Wolbrecht, assistant engineer, under Capt. C. B. Phillips, Corps of Engineers. His report in full is given at pages 911 to 916, Annual Report Chief of Engineers, U. S. Army, for 1880; it was subsequently examined by Capt. W. H. Bixby, Corps of Engineers, and Lieut. Harry Taylor, Corps of Engineers, in 1887; their very full reports are to be found at pages 958 to 968, Annual Report Chief of Engineers, U. S. Army, for 1888.

These previous examinations were made at comparatively low stages. I purposely made mine when the river at Camden was about 9 or 10 feet above low water, the total range of river here being about 32 feet. For 5 miles above Camden the river would admit of steamboat navigation if properly cleared of snags; but a draw would be needed in the Camden Bridge, which is a fine iron structure so built as to involve considerable cost for such modifications. Above a point 5 miles above Camden the slope of the river is in many places so great, and the bed is so obstructed by rock ledges and shoals, that any improvement for steamboats would be enormously expensive. Pole boats were used on this part of the river before the railroads were built, but have since entirely disappeared, and the canals constructed for their use by the State are in ruins. It is not advisable to reëstablish this method of transportation, as it has once already proved too expensive.

The three reports above mentioned based on the previous examinations have all been unfavorable to attempting any improvements; the grounds for this opinion are given in considerable detail in Captain Bixby's report. I entirely concur with him that this river is not worthy of improvement. No survey is recommended.

The bend about 4 miles below Camden referred to in the act was also examined. This portion of the river has already been surveyed. The distance around the bend is about 4 miles; across the point, about 1,300 feet. If a cut were made it would be largely through thick wood, and would be very expensive. The navigation around the bend is now as good as the balance of the river. A cut-off might easily injure the channel above by lowering the surface of the water, and in times of freshets it would considerably increase the flood-height below where the bottom lands even now require levees.

In my opinion the interests of navigation do not demand that any such cut-off be made. No further survey is recommended.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
Captain of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., February 14, 1891.

Respectfully submitted to the Chief of Engineers.

In my opinion the portion of the Wateree River, South Carolina, referred to herein, is not worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

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